

**Medicare, Hospital Utilization and Mortality:
Evidence from the Program's Origins**

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Abstract:

We examine changes in hospital utilization and mortality rates occurring after the original introduction of Medicare in July of 1966 with the most comprehensive data ever used. The analysis utilizes the “age discontinuity” design of recent studies, while accounting for pre-existing trends as done in another set of more aggregated research.

We find: i) clear evidence that Medicare increased hospital care utilization and costs among the elderly, but at a lower rate than previously found; ii) significant mortality reductions in the eligible population that exhibit an age discontinuity *only after* the introduction of Medicare – patterns not found in nations that did not introduce a Medicare-style program in the 1960's; and iii) the sharpest mortality reductions in acute causes of death (heart disease), with little change in cancer deaths. We estimate that Medicare's introduction had a cost-per-life year ratio below \$200 (in 1982-84 dollars), with a lower cost ratio for quality-adjusted life years. We then analyze changes over time in the characteristics of the “marginal” person who benefited from Medicare coverage. We find that the 65-and-over insurance discontinuity fell over time, and that the rates of decline were highest among blacks, the less-educated, poor and disabled. We further document a sharp increase in the mid-1980s in the use of coronary artery bypass graft (CABG) surgery on the Medicare eligible, which coincided with an increase in the *relative* Medicare reimbursement rate for this procedure.

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Medicare Legislation

- Passed 1965; to take effect July 1966
- Covers aged 65-and-over: i) Part A = hospitals; ii) Part B = outpatient services.
- Approximately 19 million enrolled immediately
- Large bureaucratic effort between 1965 and 1966 to get *eligible* people enrolled.
- Extended to disabled in 1973
- Medicaid rolled out in States between 1966 and 1972

“No longer will older Americans be denied the healing miracle of modern medicine. No longer will illness crush and destroy the savings they have so carefully put away over a lifetime so that they might enjoy dignity in their later years. No longer will young families see their own incomes, and their own hopes, eaten away simply because they are carrying out their deep moral obligations.”

- *President Lyndon B. Johnson, at the signing of the Medicare legislation, July 1965.*

Motivation

- Evaluate effect of major health insurance program at time of introduction.
- Vital statistics reports
 - o In 1963 45% of individuals in age groups 45-64 and 65+ had hospital and surgical insurance.
 - o In 1967 corresponding numbers are 45% and 98%
- Significant number in cohorts affected in 1966 spent much of life without any health insurance.
- Allows cleaner interpretation of results of impact of health insurance.
 - o Many going from no insurance to insurance – not from private coverage to dual coverage.
 - o Can observe age-insurance patterns before Medicare.

From 1963 to 1974, no diffs by age in growth in Blue Cross hospital insurance – ages 55-64 (65-74) rose from 35% (30%) to 40% (35%).

- Little evidence for “crowd-out”; also find no evidence of employment effects.

Previous work on utilization and costs

- Early work in several volumes of *Social Security Bulletin* (1971, 1976)
- Recent work by Amy Finkelstein (2007)
- Card, Dobkin and Maestas (2008)
- McWilliams and colleagues (2007)

Previous findings on Medicare effects on mortality/health

- Finkelstein and McKnight (2008)
- Card, Dobkin and Maestas (2008)
- McWilliams and colleagues (2007)
- Friedman (1976)

Early work in 1970s pretty good: i) have administrative data on affected population (age 65+); ii) less good on control groups; iii) exception, Medicaid “RD” work.

New data on hospital insurance and utilization

- 1963-on *National Health Interview Surveys*
- 1970-on *National Hospital Discharge Surveys*
- Cross-checked NHIS against NHDS in 1970, etc. – NHIS discharge data reliable

Advantages:

- Calculate *age-specific* utilization (and costs) → use discontinuity in eligibility *before and after* Medicare change.
- Finkelstein uses aggregate *AHA* data (and interaction with pre-existing health insurance by state). May overstate increase in utilization and costs since other things changing: i) hospital integration; ii) Medicaid; iii) increase in personnel costs due to extension of min. wage coverage (\$9-10/hr in \$2007) to hospital employees on Feb. 1, 1967 (esp. in South) – charging increase in daily expenses to Medicare (daily service charge largest component of hospital cost growth after Medicare).

Regression Equations for “age discontinuity”:

(restrict sample to 45 to 80 year-olds)

In given year:

$$y_i = \alpha + \theta_1 \cdot 1(\text{age}_{65-69}) + \theta_2 \cdot 1(\text{age}_{70-74}) + \theta_3 \cdot 1(\text{age}_{75-80}) + \lambda_1 \cdot \text{age} + \lambda_2 \cdot \text{age}^2 + \lambda_3 \cdot \text{age}^3 + \lambda_4 \cdot \text{age}^4 + \lambda_5 \cdot \text{age}^5 + X_i' \beta + \varepsilon_i$$

Change after 1963-64 = Before (B); After (A):

$$y_{it} = \alpha + \gamma_1 \cdot 1(\text{age}_{65-69}) + \gamma_2 \cdot 1(\text{age}_{70-74}) + \gamma_3 \cdot 1(\text{age}_{75-80}) + \theta_1 \cdot 1(\text{age}_{A,65-69}) + \theta_2 \cdot 1(\text{age}_{A,70-74}) + \theta_3 \cdot 1(\text{age}_{A,75-80}) + \lambda_1 \cdot \text{age} + \lambda_2 \cdot \text{age}^2 + \lambda_3 \cdot \text{age}^3 + \lambda_4 \cdot \text{age}^4 + \lambda_5 \cdot \text{age}^5 + \delta_1 \cdot 1(\text{After}) + \delta_2 \cdot \text{age} \cdot 1(\text{After}) + X_{it}' \beta + \varepsilon_{it}$$

- Inference corrected for clustering on age and heteroskedasticity.
- No discontinuities in cross-sections preceding Medicare (1963-64).
- No discontinuities in *change* before Medicare (1963-64 to 1965-66).
- Adjusting for characteristics (X) has no effect on results.

Data on Limited Activity Rates in *NHIS*

- Can use to eventually construct QALY's
- Also have data on doctor's visits (Medicare Part B) from FY 1964-on; small early on, could grow over time.

Use to distinguish effects of Medicare from Medicaid for elderly

- Medicaid eligibility not discontinuous at age 65; Medicare is
- Much of North adopted Medicaid before 1967: IL (Jan. 66), NY (Oct. 66), PA (Jan. 66), OH (July 66), MI (Oct. 66)
- Much of South after 1968: AL (Jan. 70), MS (Jan. 70), NC (Jan. 70), AR (Jan. 70), FL (Jan. 70), VA (July 69), TN (Jan. 69), SC (July 68)
- By 1968, age 65-69 ADL discontinuity as large in South as North: estimated coeff [t-ratio]; South = -42.6 [2.65], North = -30.6 [3.33]

Eventually obtain state identifiers in *NHIS*

“New” data on age-specific mortality

- International comparisons using *WHO* data: by 5-year age category and cause-of-death.
- Age-discontinuity micro results for United States using: i) 1960-1967 NBER micro mortality records; and ii) 1968-on *Mortality Detail Files*.
- Several advantages over previous studies.

Cost-Benefit Analysis

1. Construct *birth cohort-specific* survival curves
 - Know Birth year from mortality microdata from 1960-on
 - 1896 cohort only eligible for Medicare at age 70
 - 1899 cohort eligible at age 67; 1902 cohort eligible at 65
2. Life expectancy if survive to age 64
 - Median life expectancy: 79.3 for 1896 cohort; 80.3 for 1899 cohort; 80.7 for 1904 cohort
3. Hospital Discharge Rate due to Medicare
 - Ages 67-69 = 146-per-1,000
 - Ages 65-69 = 184-per-1,000
4. Average costs per discharge: \$1,250 (in \$1982-84)

Cost-Benefit ratio = \$160-\$187 per year of extended life

- Also reduction in limited-activity rates → cost-per-QALY even lower
- Britain's Natl. Inst. For Health & Clinical Excellence (NICE): limit of £30,000 cost of extending life 1-year.

What if GE effects?

1. If GE effects then we are understating Medicare's impact.
2. If GE effects then expect trend/dip in insurance, discharge, mortality at older ages below 65.
3. If GE effects then expect increase in insurance associated with increase in hospital discharge.
4. Could be spillovers after 1972, but also know that Medicare was extended to non-elderly disabled after 1972 (can test this in NHIS data since know disabled).

Using geographic variation if not GE effects?

1. Would contrast elderly-nonelderly gains between South and North.
2. Unfortunately, no "first-stage" for either hospital insurance or discharge rates.
3. Finkelstein-McKnight get very large confidence intervals – can't rule out much.
 - Small first stage → bigger s.e.'s
 - Measurement error in "treatment" → bigger s.e.'s and attenuated effects.
 - Measurement error in outcome (interpolated state populations) → bigger s.e.'s

Changes in Marginal Beneficiary

- Estimate age 65-69 discontinuity in prob. of hospital insurance, separately by demographic/socioeconomic group.
- Ages 45 to 69, fourth-order polynomial in age.

Large decline in age-65 insurance discontinuity over time

- Greater decline for blacks, less-educated and poor.
- These groups have greater increase over time in insurance rate of 60-64 year-olds.

Corresponds with general decline in hospital discharge rate discontinuity over time.

- Discharge discontinuity also countercyclical (peaks in recessions).

Coronary Artery Bypass Graft (CABG)

Large discontinuities in CABG *among discharges* in Card, Dobkin, Maestas.

CABG developed May 1967 (Cleveland Clinic)

- First coronary artery bypass performed May 2, 1960 (NYC)
- Discontinuity in *overall* discharge rates high in early 1970's, though no CABG discontinuity *among discharges*. CABG use increased for eligibles, but being used when necessary.
- Discontinuity in *overall* discharge rates fell by late 1980's; more so for disadvantaged. Even so, large discontinuity in CABG *among discharges*. Implies using CABG more on *less-disadvantaged* admits eligible for Medicare → possibly when unnecessary.
- 1984 Medicare reimbursement for CABG = \$24,000
- 1984 cusp of "selective contracting" era: insurance companies begin to "shop" for CABG providers with lowest price. CABG reimbursement under this contract = \$10-12K.
- Medicare inability to lower reimbursement due to "downward sticky prices".

Coronary Angioplasty first developed Sept 16, 1977 (Zurich)

- By mid-1980s, adopted by many leading medical centers.
- Randomized trials show much more cost-effective than CABG.

As of late 1980's

- Relatively small insurance discontinuities; decrease larger among blacks and disadvantaged.
- Relatively small hospital discharge discontinuities, both all and heart disease admissions.
- Relatively large CABG discontinuities among discharges. Occurring even as Angioplasty becomes available.
- Mortality discontinuities for heart disease don't improve → more money, worse outcomes?
- More research.

Current Discussion

Atul Gawande (*New Yorker*)

- Dartmouth findings on variation in Medicare costs across areas
- Bad incentives of fee-for-service
- Some medical care urgent; some “unnecessary”

Peter Singer (*NY Times Magazine*)

- Ethical concerns over return to marginal dollar – i.e., optimal allocation of finite resources.
- Use evidence on cost-effectiveness of procedures (“death panels”). Currently not in health care reform bill.
- Private insurance already “rationing” care based on pre-existing conditions, etc.

Issues with Census population counts by age

- Unrevised (Postcensal)
 - Revised (Intercensal)
 - Revision in the 1960s because of Medicare
 - o even before Medicare came into effect
- “Impact of Medicare on Demography” (Myers 1966)

Unrevised counts match *NHIS* implied population totals better than Revised counts.

Can see if Medicare claims due to behavioral response

- Incomplete birth records (and Social Security Numbers) in U.S. before 1930's. Implies many aged in their 50s and 60s during 1960's didn't have birth certificates or SSN's, esp. in poorer areas/states.
- Have incentive to claim aged 65+ when in truth they are 60-64 years old.
- Incentive should be stronger in areas/states where there is less health insurance for 60-64 year olds.
- Can test this after collecting unrevised Census population counts by state.

Table 1: Discontinuity in hospital insurance rates at ages 65-and-over, among individuals aged 45 to 80
[absolute value of t-ratio]

	Discontinuity in hospital insurance rate (per 100) by age group (deviated from fifth-order polynomial in age)					
	Unadjusted for individual characteristics			Adjusted for individual characteristics		
	FY 1963 (1a)	Growth after FY 1963 by		FY 1963 (2a)	Growth after FY 1963 by	
		FY 1968 (1b)	CY 1974 (1c)		FY 1968 (2b)	CY 1974 (2c)
A. All races						
Ages 65 to 69	-1.88 [1.20]	23.68*** [19.18]	18.79*** [16.10]	-0.14 [0.10]	24.79*** [21.57]	17.80*** [16.08]
Ages 70 to 74	0.46 [0.15]	30.38*** [19.70]	24.61*** [16.86]	2.44 [0.86]	30.91*** [21.53]	23.90*** [17.28]
Ages 75 to 80	-1.94 [0.42]	38.79*** [20.12]	34.21*** [18.89]	0.83 [0.19]	39.61*** [22.08]	33.05*** [19.25]
Year effect	---	4.98 [1.49]	-3.34 [1.03]	---	3.11 [1.03]	-2.55 [0.84]
Year-age trend ($\div 10$)	---	-0.01 [0.01]	2.71*** [4.47]	---	-0.37 [0.65]	1.42*** [2.53]
R-squared	0.042	0.058	0.097	0.212	0.207	0.217
Sample Size	39,164	78,298	73,445	39,164	78,298	73,445
B. Whites only						
Ages 65 to 69	-1.97 [1.22]	22.56*** [17.96]	17.87*** [15.07]	-0.57 [0.38]	23.68*** [20.00]	16.68*** [14.74]
Ages 70 to 74	1.47 [0.47]	28.48*** [18.12]	23.61*** [15.97]	2.53 [0.85]	29.16*** [19.69]	22.61*** [16.02]
Ages 75 to 80	0.04 [0.01]	38.23*** [19.54]	33.71*** [18.29]	1.44 [0.32]	38.84*** [21.01]	32.42*** [18.41]
Sample Size	35,545	71,099	66,755	35,545	71,099	66,755
C. Blacks only						
Ages 65 to 69	-2.36 [0.42]	36.01*** [7.54]	30.66*** [6.67]	1.23 [0.24]	37.14*** [8.20]	30.84*** [6.94]
Ages 70 to 74	-15.96 [1.57]	54.47*** [9.28]	44.40*** [7.83]	-5.60 [0.57]	53.06*** [9.45]	42.39*** [7.58]
Ages 75 to 80	-27.36* [1.82]	48.45*** [6.43]	46.65*** [6.71]	-13.66 [0.94]	49.84*** [7.02]	45.84*** [6.83]
Sample Size	3,358	6,678	6,183	3,358	6,678	6,183

Notes: Samples based on forty-five to eighty year-olds in the *National Health Interview Surveys*. Outcome variable is percent with hospital insurance. FY 1963 and FY 1968 are for fiscal years (July 1 to June 30); CY 1974 is for calendar year (January 1 to December 31). All analyses are weighted by *NHIS* annual sampling weights and adjust for a fifth-order polynomial in age, year effects, and year effects interacted with age. Individual characteristics in columns (2a) to (2c) include indicators for gender, race, region of residence, education and income category fixed effects, unemployment status, married/separated/divorced/widowed status, and (peace-time/wartime) veteran status. Estimated standard errors are corrected for heteroskedasticity.

*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Table 2: Discontinuity in hospital discharge rates at ages 65-and-over, among individuals aged 45 to 80
[absolute value of t-ratio]

	Discontinuity in discharge rates from short-stay hospital in past 12 months (per 1,000) (deviated from fifth-order polynomial in age)					
	Unadjusted for individual characteristics			Adjusted for individual characteristics		
	1964-1966 (1a)	Growth after 1964-66 by		1964-1966 (2a)	Growth after 1964-66 by	
		1968-1969 (1b)	1970-1972 (1c)		1968-1969 (2b)	1970-1972 (2c)
A. All races						
Ages 65 to 69	3.11 [0.29]	27.74** [2.50]	35.32*** [3.13]	-5.06 [0.43]	26.60** [2.39]	35.44*** [2.94]
Ages 70 to 74	-23.25 [1.21]	46.35*** [3.69]	31.46*** [2.81]	-30.08 [1.38]	45.74*** [3.61]	33.42*** [2.93]
Ages 75 to 80	-83.97*** [3.21]	75.98*** [3.89]	83.10*** [6.45]	-87.19*** [2.95]	73.68*** [3.75]	82.33*** [6.25]
Year effect	---	14.99 [0.53]	8.03 [0.36]	---	16.79 [0.59]	8.84 [0.38]
Year-age trend ($\div 10$)	---	-3.92 [0.72]	-0.03 [0.01]	---	-4.15 [0.75]	-0.69 [0.16]
Sample Size	114,846	228,944	225,884	114,846	228,944	225,884
B. Whites only						
Ages 65 to 69	2.62 [0.23]	27.74** [2.00]	37.10*** [2.99]	-4.97 [0.41]	26.20* [1.89]	36.99*** [2.79]
Ages 70 to 74	-23.66 [1.27]	46.27*** [3.14]	31.38** [2.63]	-29.58 [1.43]	45.49*** [3.07]	32.40*** [2.69]
Ages 75 to 80	-74.33*** [2.70]	68.92*** [3.35]	87.39*** [6.32]	-77.24** [2.58]	66.10*** [3.18]	85.70*** [6.08]
Year effect	---	9.27 [0.28]	2.87 [0.12]	---	11.29 [0.34]	2.56 [0.10]
Year-age trend ($\div 10$)	---	-2.92 [0.46]	0.48 [0.11]	---	-3.11 [0.48]	0.03 [0.01]
Sample Size	104,688	208,204	205,323	104,688	208,204	205,323

Notes: See notes to Table 1. Samples based on forty-five to eighty year-olds in the *National Health Interview Surveys*. Outcome variable is number of discharges from short-stay hospital in past twelve months per 1,000 individuals. For 1964 to 1966, discharges are for fiscal years; for 1968 they are for both fiscal and calendar year; 1969 and 1970 to 1972 are for calendar years. Estimated standard errors are corrected for heteroskedasticity and clustering at the age-level over time.
*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Table 3: Discontinuity in activity limitation at ages 65-and-over, among individuals aged 45 to 80
[absolute value of t-ratio]

	Discontinuity in activity limitation rate (per 1,000), deviated from fifth-order polynomial in age							
	Unadjusted for individual characteristics				Adjusted for individual characteristics			
	1965-1966 (1a)	Change after 1965-1966 by			1965-1966 (2a)	Change after 1965-1966 by		
		1969-1970 (1b)	1971-1972 (1c)	1973-1974 (1d)		1969-1970 (2b)	1971-1972 (2c)	1973-1974 (2d)
A. All races								
Ages 65 to 69	13.64 [1.13]	-34.98*** [4.09]	-32.10*** [4.77]	-53.69*** [3.79]	-8.89 [0.80]	-32.33*** [3.71]	-33.28*** [4.81]	-45.20*** [3.24]
Ages 70 to 74	15.66 [0.99]	-57.89*** [5.23]	-45.24*** [4.53]	-83.89*** [6.02]	-5.99 [0.34]	-60.61*** [5.64]	-43.71*** [5.03]	-69.27*** [4.85]
Ages 75 to 80	-5.89 [0.26]	-51.66*** [3.96]	-45.00*** [3.51]	-112.15*** [6.46]	-19.04 [0.80]	-60.38*** [4.67]	-51.48*** [4.00]	-102.56*** [5.59]
Year effect	---	-2.75 [0.14]	34.43 [1.38]	-34.67 [1.13]	---	-3.03 [0.15]	33.18 [1.35]	-2.35 [0.07]
Year-age trend ($\div 10$)	---	0.70 [0.18]	-3.84 [0.87]	14.21** [2.44]	---	3.97 [1.03]	0.60 [0.13]	14.01** [2.27]
R-squared	0.080	0.070	0.067	0.066	0.157	0.148	0.149	0.149
Sample Size	77,994	148,629	155,797	147,154	77,994	148,629	155,797	147,154
B. Whites only								
Ages 65 to 69	9.83 [0.69]	-39.66*** [4.50]	-36.95*** [4.60]	-59.50*** [3.85]	-9.33 [0.74]	-37.36*** [4.28]	-40.10*** [5.22]	-51.20*** [3.39]
Ages 70 to 74	8.50 [0.44]	-59.65*** [5.04]	-50.05*** [4.68]	-85.59*** [5.62]	-8.21 [0.41]	-63.03*** [5.47]	-49.98*** [5.27]	-70.61*** [4.51]
Ages 75 to 80	-13.09 [0.48]	-56.23*** [4.15]	-44.24*** [3.24]	-115.87*** [6.24]	-20.22 [0.73]	-63.58*** [4.65]	-53.97*** [4.02]	-108.18*** [5.51]
Sample Size	71,243	135,198	141,787	134,120	71,243	135,198	141,787	134,120

Notes: See notes to Table 1. Samples based on forty-five to eighty year-olds in the *National Health Interview Surveys*. Outcome variable is indicator for activity limitation due to chronic conditions (per 1,000 individuals). Fiscal years are used for 1965 to 1966; calendar years for every other year. Estimated standard errors are corrected for heteroskedasticity and clustering at the age-level over time.

*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Table 4: Discontinuity in mortality rates at ages 65-and-over, among those aged 45 to 80
[absolute value of t-ratio]

	Discontinuity in mortality rate (per 10,000) by age group and cause (deviated from fifth-order polynomial in age)					
	All races			Whites only		
	Change after 1965-1966 by			Change after 1965-1966 by		
	1969-1970 (1a)	1971-1972 (1b)	1973-1974 (1c)	1969-1970 (2a)	1971-1972 (2b)	1973-1974 (2c)
A. All-cause mortality						
Ages 65 to 69	-13.08*** [4.53]	-17.02*** [6.99]	-20.30*** [5.93]	-9.90*** [4.52]	-11.67*** [4.62]	-14.09*** [4.78]
Ages 70 to 74	-6.07 [0.77]	-8.26 [1.50]	-8.64* [1.92]	-10.56* [1.70]	-14.41*** [2.70]	-16.97*** [6.19]
Ages 75 to 80	-17.75*** [2.93]	-10.60** [2.23]	-24.03*** [4.52]	-19.67*** [3.52]	-15.51*** [3.46]	-27.77*** [6.80]
B. Heart disease mortality						
Ages 65 to 69	-5.93*** [4.92]	-8.67*** [8.29]	-10.27*** [6.18]	-5.03*** [4.65]	-6.74*** [5.49]	-8.19*** [5.04]
Ages 70 to 74	-1.31 [0.37]	-4.29 [1.50]	-4.92** [2.64]	-3.48 [1.21]	-6.94** [2.51]	-8.76*** [6.45]
Ages 75 to 80	-7.64*** [2.79]	-5.31* [1.98]	-13.58*** [5.11]	-8.70*** [3.30]	-7.57*** [2.85]	-15.22*** [7.76]
C. Stroke mortality						
Ages 65 to 69	-1.89** [2.62]	-2.97*** [6.44]	-3.51*** [6.21]	-1.44*** [5.35]	-2.03*** [6.50]	-2.42*** [6.39]
Ages 70 to 74	-1.24 [1.51]	-2.63*** [2.72]	-3.41*** [4.06]	-1.74*** [3.68]	-3.53*** [4.44]	-4.49*** [7.34]
Ages 75 to 80	-5.34*** [3.61]	-5.50*** [4.58]	-7.83*** [5.29]	-5.99*** [4.21]	-6.49*** [5.64]	-8.69*** [6.09]
D. Cancer mortality						
Ages 65 to 69	-2.36*** [3.74]	-1.71*** [2.92]	-2.88*** [3.61]	-1.61*** [2.76]	-0.60 [0.90]	-1.53*** [2.01]
Ages 70 to 74	-1.20 [0.68]	0.39 [0.36]	0.92 [0.99]	-1.89 [1.24]	-0.49 [0.43]	-0.36 [0.48]
Ages 75 to 80	0.51 [0.51]	3.65*** [3.92]	2.64*** [2.90]	0.52 [0.58]	3.13*** [3.37]	2.51*** [3.04]

Notes: Data consist of mortality rates for forty-five to eighty year-olds calculated at the year-by-age level from the *National Mortality Detail Files* (see text for further details). The outcome variable is the mortality rate (per 10,000 individuals) in each calendar year. All analyses use cell population counts as frequency weights and adjust for a fifth-order polynomial in age, year effects, and year effects interacted with age. Estimated standard errors are corrected for heteroskedasticity and clustering at the age-level over time.

*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Table 5: Cost-per-life year ratios (for whites)

	Birth year		
	1896 (1)	1899 (2)	1904 (3)
Age at end of 1966	70	67	62
Ages eligible for Medicare	70+	67+	65+
Ages of added Medicare relative to 1896 cohort	---	67 to 69	65 to 69
Added discharges (implied) relative to 1896 cohort	---	146.5 (per 1,000)	184.2 (per 1,000)
Median life expectancy (for survivors to age 64)	79.28	80.26	80.73
Percent surviving to			
Age 71	80.2	81.2	81.7
Age 76	62.3	64.6	66.3
Age 81	43.7	47.2	49.0
Age 85	30.0	33.0	34.2
Cost-per-life year (\$1982-84)		\$187.30	\$159.45
Cost-per-QALY (\$1982-84)			

Notes: Additional discharges calculated from regression similar to that used in Table 2, column (1c) for whites, except using sample of 45 to 69 year-olds and allowing for different indicators for each age between 65 and 69. Use the age-specific survival rates for each birth cohort as weights when summing up the additional discharges. Average cost-per-discharge \$1,250 in 1982-84 dollars. See text for more details.

Table 6A: Hospital insurance rates for South and North regions, before and after Medicare
(estimated standard error)

	Hospital insurance rates (per 100) by region and age group									
	July 1, 1962 to June 30, 1963					<i>Growth</i> by 1974 Calendar Year				
	age 5-14 (1a)	age 35-44 (1b)	age 45-54 (1c)	age 55-64 (1d)	age 65-74 (1e)	age 5-14 (2a)	age 35-44 (2b)	age 45-54 (2c)	age 55-64 (2d)	age 65-74 (2e)
A. All races										
South	56.94	68.99	68.93	63.02	53.71	20.93*** (0.73)	14.52*** (0.89)	14.11*** (0.90)	17.62*** (1.09)	42.23*** (1.10)
North	78.79	83.26	82.62	79.49	66.25	10.01*** (0.45)	7.06*** (0.54)	8.25*** (0.54)	10.23*** (0.65)	31.89*** (0.73)
South – North	-21.86*** (0.62)	-14.28*** (0.76)	-13.69*** (0.79)	-16.47*** (0.97)	-12.54*** (1.23)	10.92*** (0.86)	7.46*** (1.04)	5.86*** (1.05)	7.39*** (1.27)	10.34*** (1.32)
B. Whites only										
South	63.97	72.21	72.52	66.64	58.52	17.87*** (0.79)	13.83*** (0.92)	13.25*** (0.93)	16.66*** (1.14)	38.14*** (1.18)
North	81.82	84.73	83.83	80.90	67.55	8.27*** (0.45)	6.56*** (0.53)	8.02*** (0.54)	9.60*** (0.65)	30.75*** (0.73)
South – North	-17.86*** (0.67)	-12.51*** (0.80)	-11.31*** (0.82)	-14.26*** (1.03)	-9.03*** (1.31)	9.59*** (0.91)	7.28*** (1.06)	5.22*** (1.07)	7.06*** (1.31)	7.39*** (1.39)

Notes: Estimated standard errors corrected for heteroskedasticity.

*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Comparison of difference in insurance rates for 55-64 and 65-74 year-olds in the South versus North.

1. All races
 - i) July 1962 to June 1963 = 3.93 (per 100), [t-ratio = 2.51]
 - ii) *Growth* by 1974 Calendar year = 2.95 [1.62]
2. Whites only
 - i) July 1962 to June 1963 = 5.23 (per 100), [t-ratio = 3.14]
 - ii) *Growth* by 1974 Calendar year = 0.33 [0.17]

Table 6B: Growth in hospital discharge rates after Medicare for South and North regions
(estimated standard error)

	<i>Growth</i> in hospital discharge rates (per 1,000) between 1964-1966 and 1970-1972				
	age 5-14 (1)	age 35-44 (2)	age 45-54 (3)	age 55-64 (4)	age 65-74 (5)
A. All races					
South	3.26 (2.74)	-9.31 (9.97)	15.08 (10.44)	2.55 (9.06)	42.95 ^{***} (13.63)
North	2.51 (2.56)	4.14 (4.27)	9.83 ^{**} (4.33)	8.12 (5.42)	30.66 ^{***} (9.77)
South – North	0.75 (3.59)	-13.45 (8.47)	5.25 (11.93)	-5.57 (8.12)	12.29 (16.24)
B. Whites only					
South	0.83 (2.71)	-15.62 [*] (9.27)	8.34 (12.61)	-5.34 (9.80)	38.65 ^{***} (13.67)
North	1.31 (2.85)	0.48 (5.13)	8.86 (5.32)	7.42 (5.21)	31.37 ^{***} (10.23)
South – North	-0.48 (3.16)	-16.10 [*] (8.30)	-0.52 (13.76)	-12.76 (10.02)	7.28 (13.91)

Notes: Estimated standard errors corrected for heteroskedasticity and clustering at the age-level over time.
^{***} significant at 1-percent level, ^{**} significant at 5-percent level, ^{*} significant at 10-percent level

Comparison of difference in discharge rates for 55-64 and 65-74 year-olds in the South versus North.

3. All races, *Growth* between 1964-66 and 1970-72 = 17.86 [0.97]
4. Whites only, *Growth* between 1964-66 and 1970-72 = 20.04 [1.15]

Table 7: Discontinuity in hospital insurance rate at age-65 across time, individuals aged 45 to 69
[absolute value of t-ratio]

	Insurance rate at age 65 (per 100), deviated from fourth-order polynomial in age					
	1963 FY (1)	1968 CY (2)	1974 CY (3)	1978 CY (4)	1984 CY (5)	1986 CY (6)
All races	-2.98 [1.72] {71.7}	17.84*** [14.36] {78.9}	15.89*** [14.05] {83.5}	10.71*** [11.33] {89.3}	9.01*** [9.44] {89.7}	7.27*** [5.63] {89.4}
{ages 60-64 rate}						
Sample Size	32,875	31,459	28,613	26,502	24,514	14,193
Whites	-3.24 [1.81] {74.3}	16.39*** [13.24] {81.1}	15.13*** [13.50] {85.2}	9.58*** [10.07] {90.2}	8.06*** [8.62] {91.0}	7.65*** [5.99] {90.3}
Blacks	0.54 [0.09] {46.3}	30.14*** [5.46] {57.5}	20.39*** [3.93] {68.1}	18.81*** [4.63] {81.7}	15.60*** [3.39] {79.3}	0.58 [0.10] {81.6}
<u>Whites only</u>						
HS graduate or less	-3.46 [1.75] {72.6}	18.42*** [13.21] {79.2}	16.39*** [12.81] {84.0}	9.97*** [8.97] {89.4}	8.41*** [7.31] {89.9}	9.08*** [6.01] {89.4}
Some college or more	-6.39 [1.61] {86.0}	6.88*** [2.95] {90.7}	9.39*** [4.24] {91.1}	6.25*** [3.71] {94.6}	4.54*** [3.31] {95.5}	3.41 [1.72] {95.0}
Below 150% of poverty line	-0.73 [0.22] {52.8}	30.09*** [8.45] {58.6}	28.52*** [9.49] {70.3}	15.81*** [5.88] {80.7}	17.29*** [4.92] {75.9}	16.08*** [3.00] {72.8}
Above 150% of poverty line	-2.03 [0.99] {83.9}	12.66*** [10.56] {87.0}	8.02*** [7.02] {90.8}	5.09*** [5.38] {94.4}	5.24*** [6.00] {94.8}	4.54*** [4.15] {95.2}

Notes: See notes to Table 1. Samples based on forty-five to sixty-nine year-olds in the *National Health Interview Surveys*. Entries are the estimated coefficient on an indicator equal to one if the individual is aged 65 to 69 from year-specific regressions that adjust for a fourth-order polynomial in age. Estimated standard errors are corrected for heteroskedasticity. For a two-person household, 150 percent of the poverty line (median income) is \$2,982 (\$4,868) in 1963, \$3,393 (\$6,809) in 1968, \$4,817 (\$10,406) in 1974, \$6,374 (\$14,165) in 1978, and \$10,707 (\$24,565) in 1986. The income cutoffs used in the *NHIS* for 150 percent of the poverty line are below \$3,000 in 1963 and 1968, below \$5,000 in 1974, below \$7,000 in 1978, and below \$10,000 in 1986.

*** significant at 1-percent level, ** significant at 5-percent level

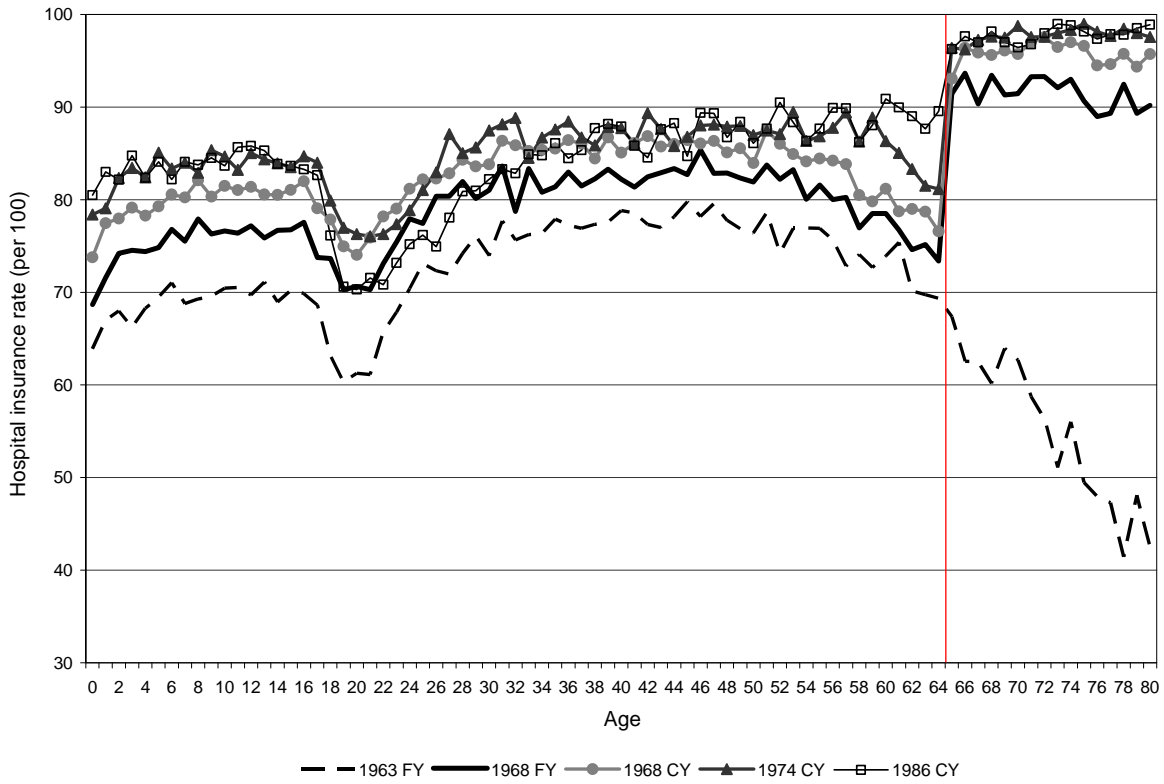
Table A1: Discontinuity in hospital discharge rates at ages 65-and-over, among individuals aged 45 to 80
[absolute value of t-ratio]

	Discontinuity in discharge rates from short-stay hospital in past 12 months (per 1,000) (deviated from fifth-order polynomial in age)					
	Unadjusted for individual characteristics			Adjusted for individual characteristics		
	<i>Growth after 1964-66 by</i>			<i>Growth after 1964-66 by</i>		
	1968-1969	1970-1972	1973-1974	1968-1969	1970-1972	1973-1974
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)
A. All races						
Ages 65 to 69	22.55*** [3.27]	35.28*** [3.91]	25.37*** [3.24]	21.12*** [2.94]	34.55*** [3.52]	19.28** [2.44]
Ages 70 to 74	39.19*** [6.31]	31.40*** [3.92]	25.23*** [5.07]	38.18*** [6.20]	32.18*** [3.77]	20.48*** [4.14]
Ages 75 to 80	66.73*** [4.93]	83.03*** [11.80]	72.51*** [5.32]	63.92*** [4.73]	80.72*** [11.54]	64.71*** [4.77]
Year effect	-6.06* [1.94]	7.87** [2.30]	22.82*** [6.66]	-5.48* [1.75]	5.16 [1.43]	23.58*** [5.93]
Sample Size	228,944	225,884	184,006	228,944	225,884	184,006
B. Whites only						
Ages 65 to 69	23.88** [2.59]	37.74*** [3.53]	25.82** [2.37]	22.11** [2.33]	37.02*** [3.18]	19.50* [1.78]
Ages 70 to 74	40.96*** [5.85]	32.26*** [3.49]	30.50*** [6.43]	39.83*** [5.80]	32.45*** [3.36]	25.00*** [5.06]
Ages 75 to 80	62.05*** [4.98]	88.53*** [9.78]	67.43*** [4.22]	58.78*** [4.67]	85.76*** [9.58]	59.60*** [3.78]
Year effect	-6.38* [1.84]	5.47 [1.46]	20.97*** [6.48]	-5.40 [1.51]	2.71 [0.67]	21.83*** [5.36]
Sample Size	208,204	205,323	167,565	208,204	205,323	167,565

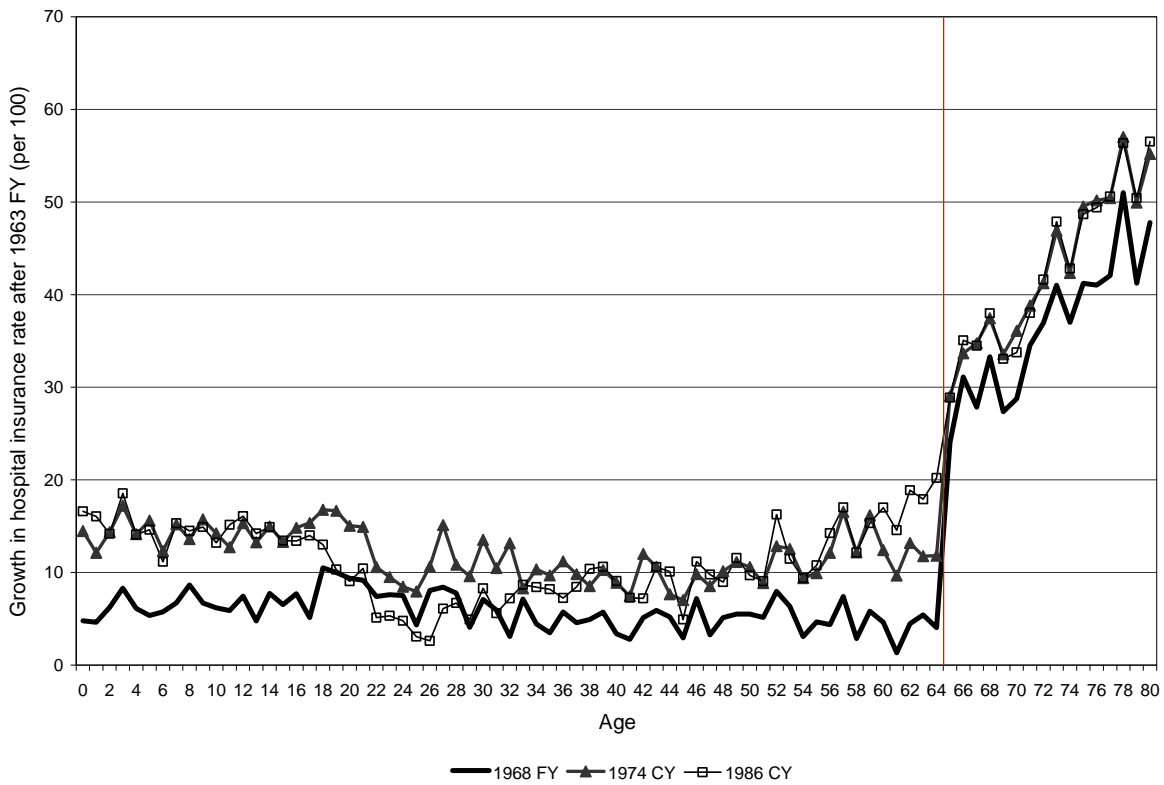
Notes: See notes to Table 2. Samples based on forty-five to eighty year-olds in the *National Health Interview Surveys*.
*** significant at 1-percent level, ** significant at 5-percent level, * significant at 10-percent level

Figure 1: Hospital Insurance rates in the United States, by age and year

A. Percent with hospital insurance



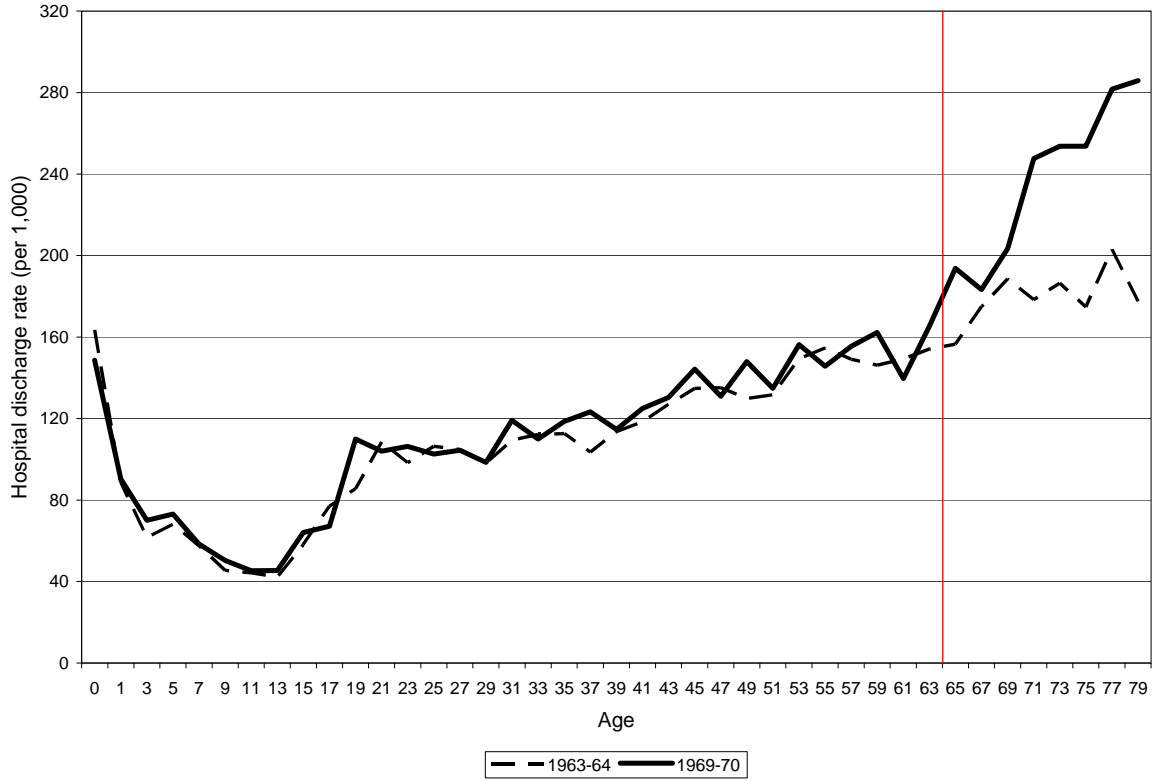
B. Growth in percent with hospital insurance after 1963 fiscal year



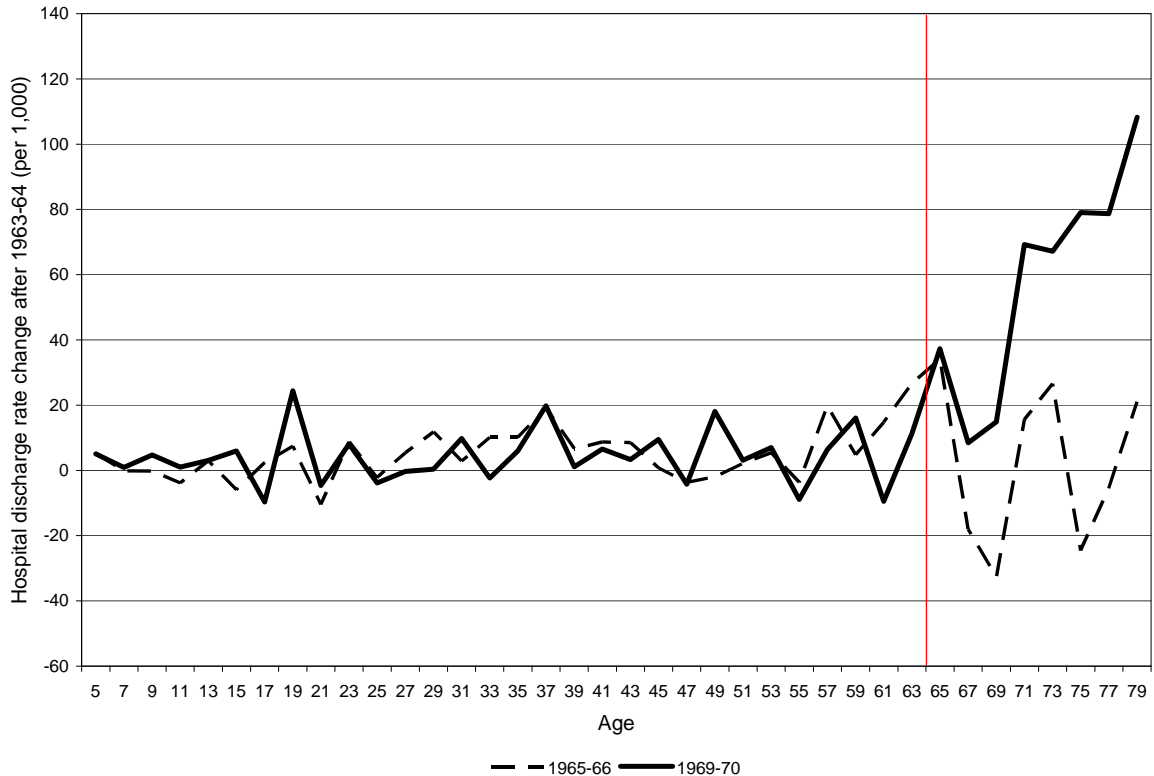
Notes: Data come from the *National Health Interview Surveys*.

Figure 2: Hospital Discharge rates from the *National Health Interview Survey*,
For all races by age and year

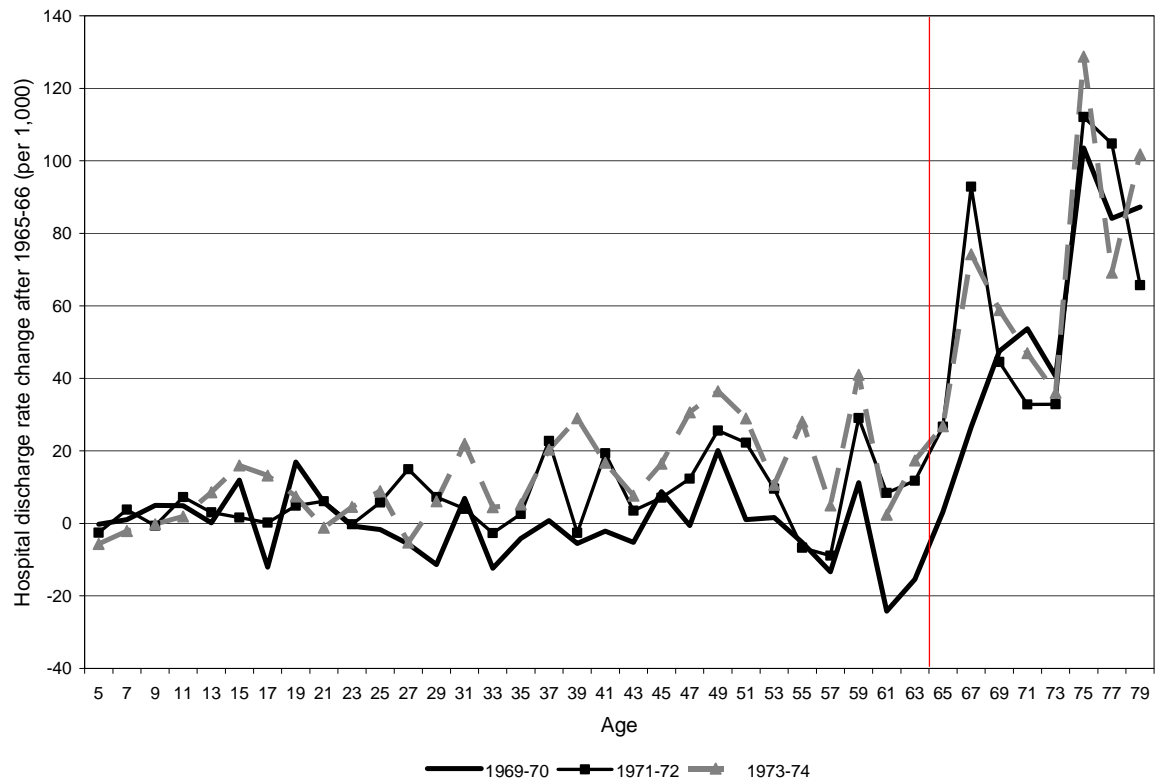
A. Hospital discharge rate per 1,000 individuals



B. Growth in hospital discharge rate after 1963 to 1964



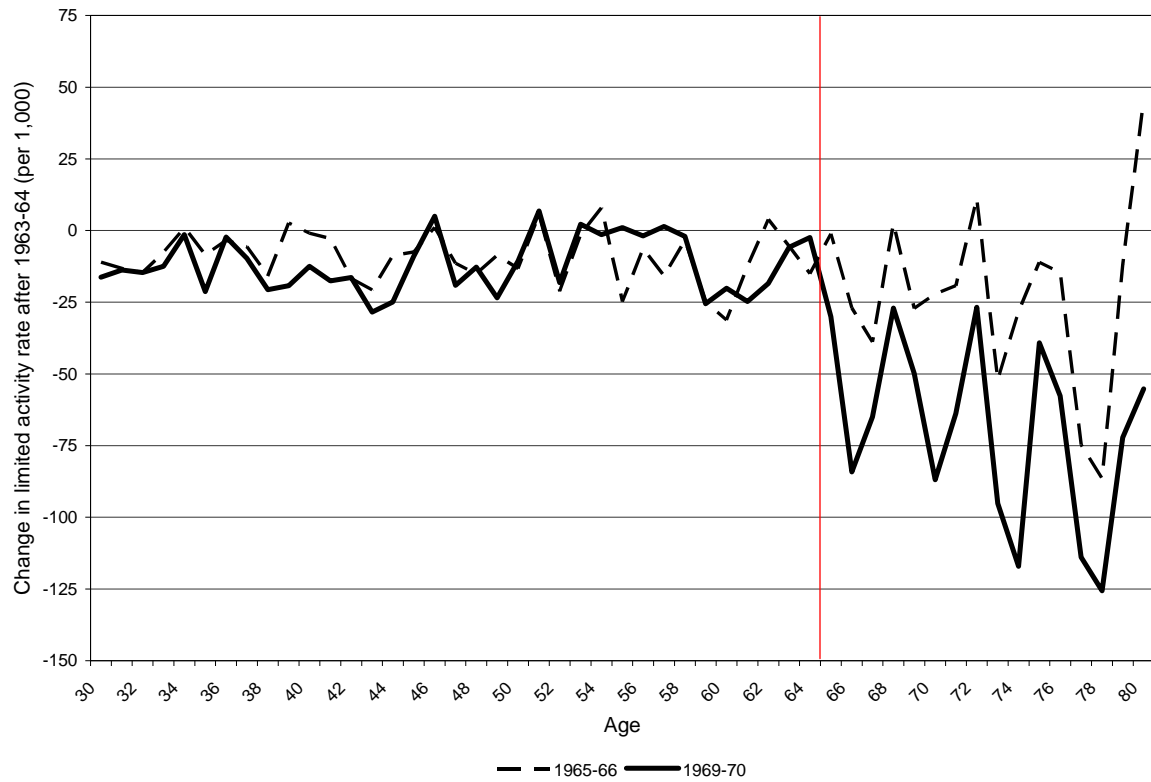
C. Growth in hospital discharge rate after 1965 to 1966



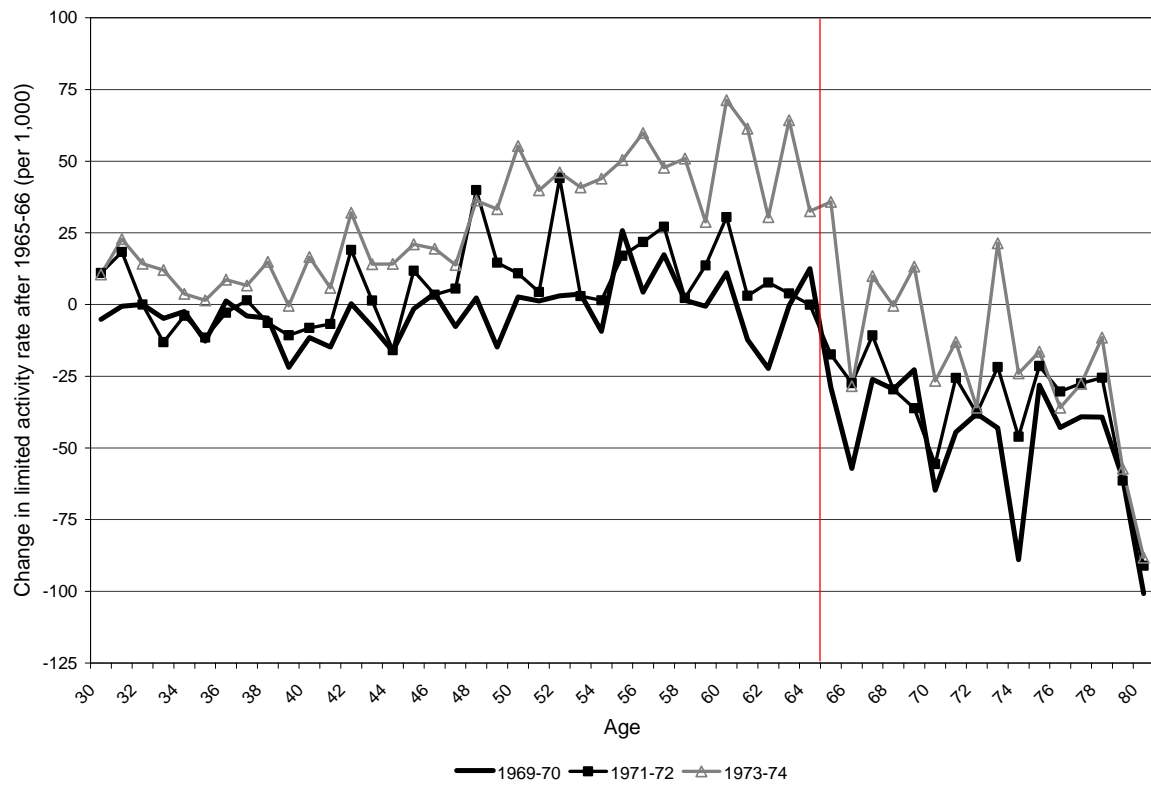
Notes: Data come from the *National Health Interview Surveys*. Discharges due to delivery of infant are excluded from the hospital discharge rate.

Figure 3: Limited Activity Rates (due to chronic conditions), per 1,000 individuals

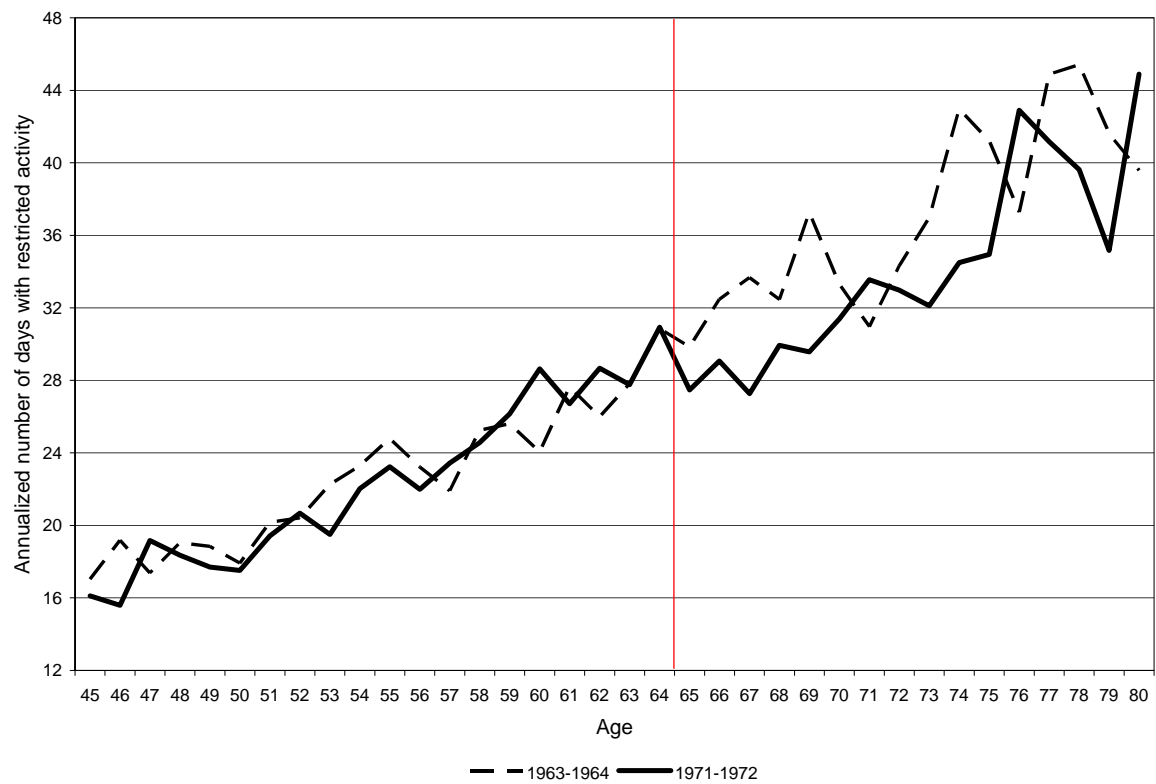
A. Change in limited activity rate relative to 1963-1964



B. Change in limited activity rate relative to 1965-1966



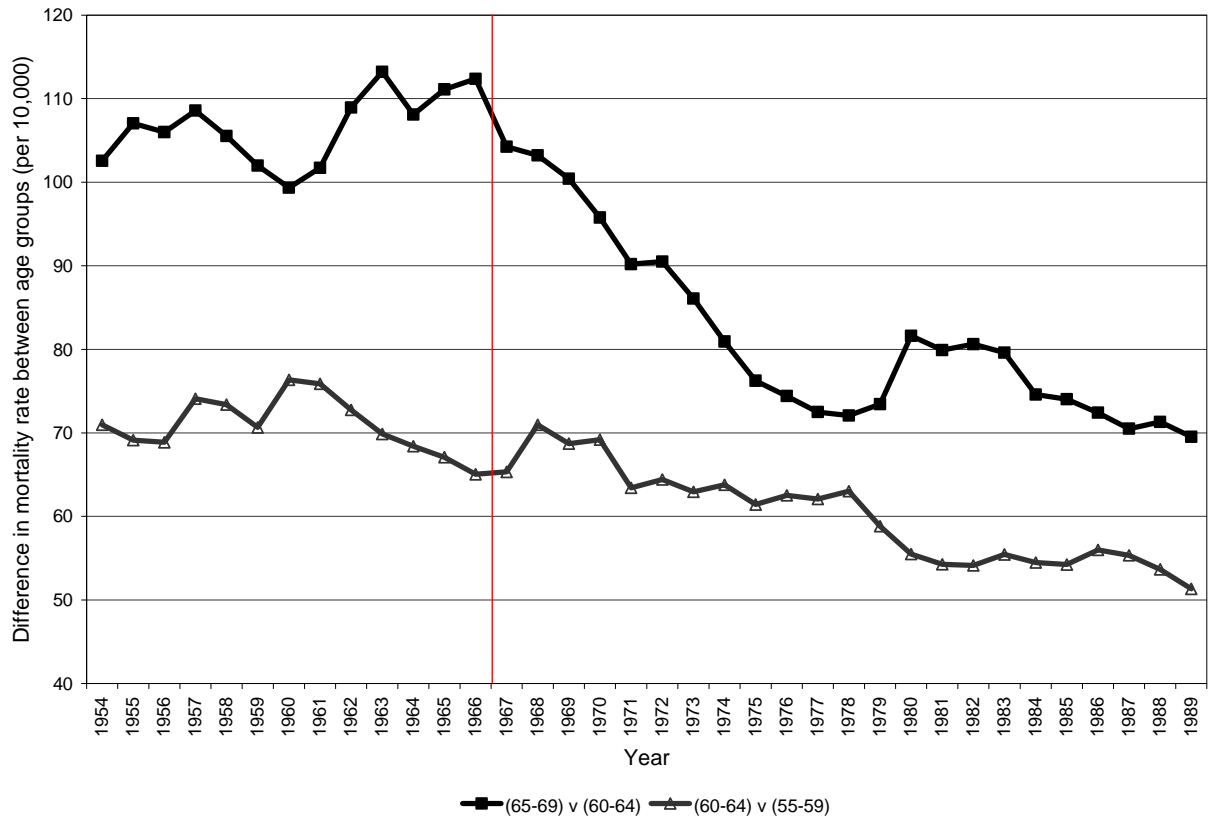
C. Annualized number of days with restricted activity



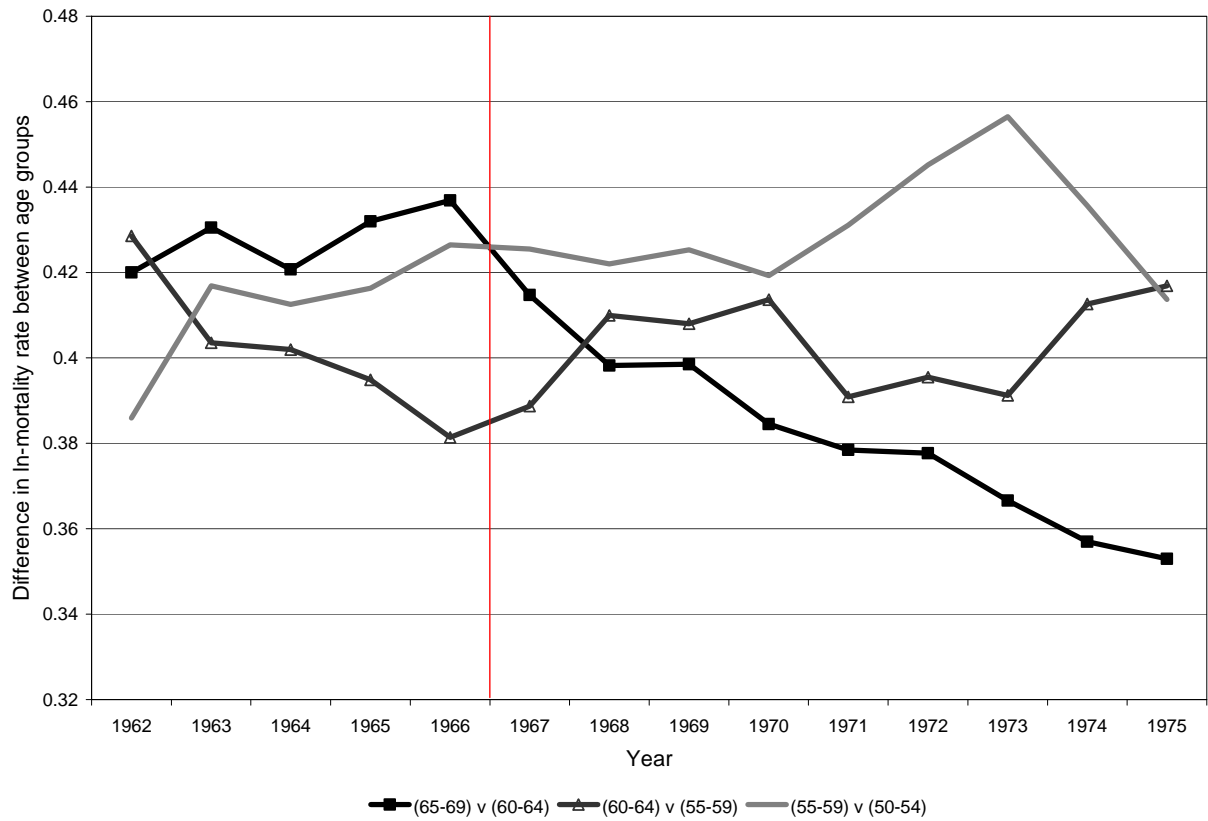
Notes: Estimated discontinuity effects [absolute value of t-ratio] for ages 45-80 deviated from 5th-order polynomial, year and year-age effects: age 65-69 = -5.46 [3.92]; age 70-74 = -4.16 [2.06]; age 75-79 = 4.35 [1.59]

Figure 4: Mortality rates over time in the United States, differences across age groups

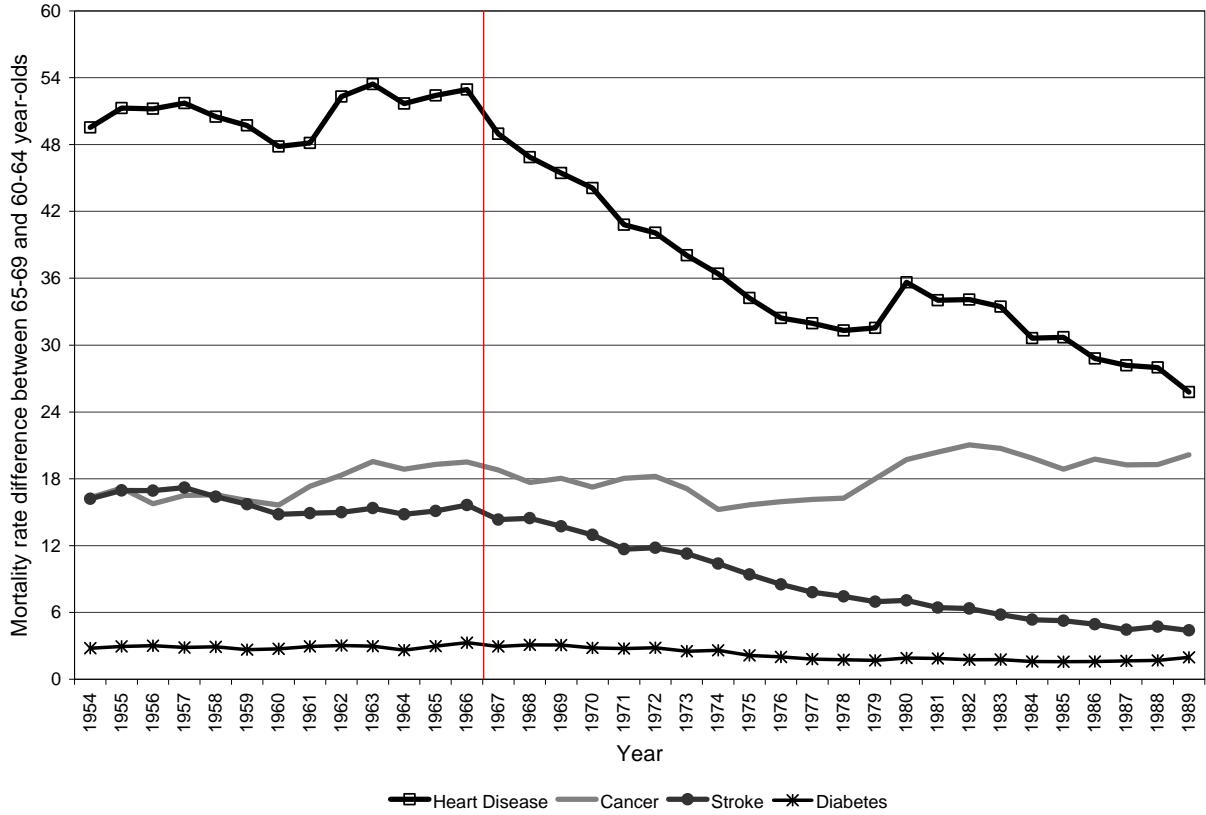
A. Age group differences in all-cause mortality rates (per 10,000 individuals)



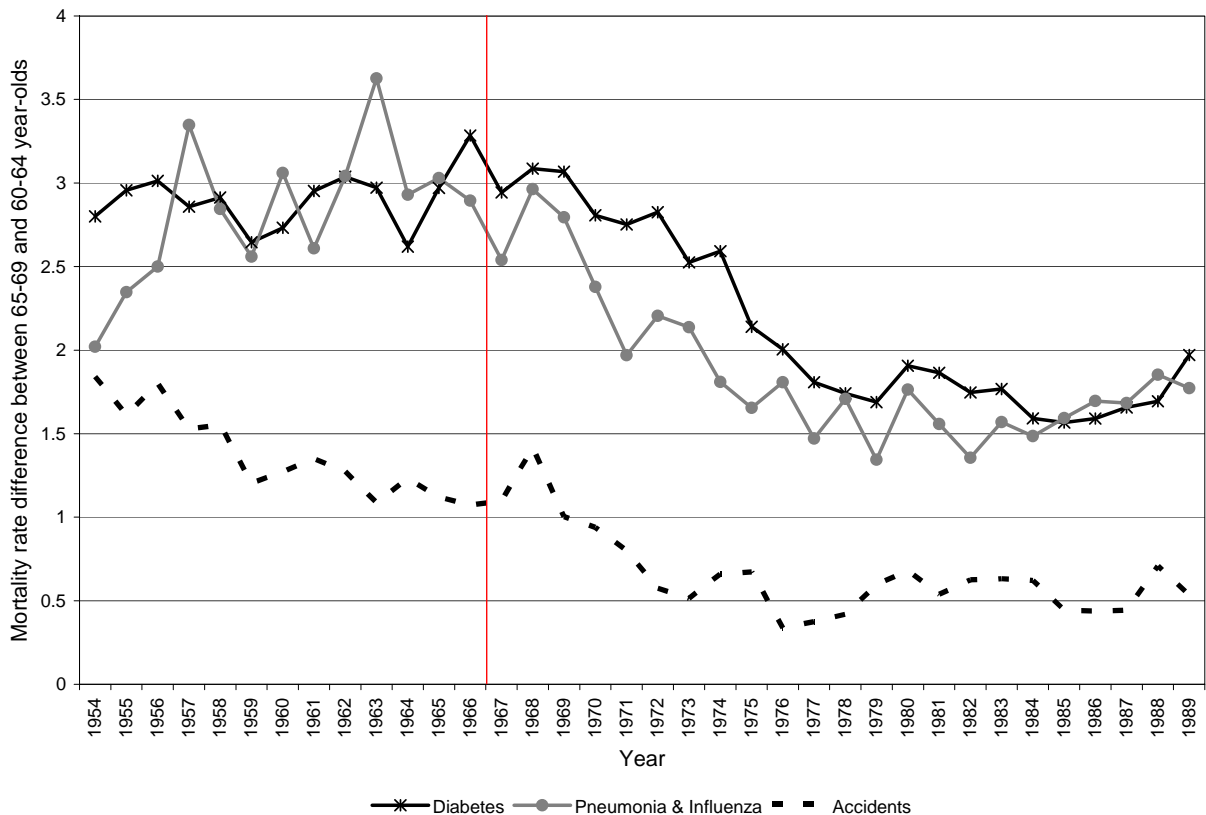
B. Age group differences in natural logarithm of all-cause mortality rate



C. Mortality rate differences between 65-69 and 60-64 year olds, by cause of death



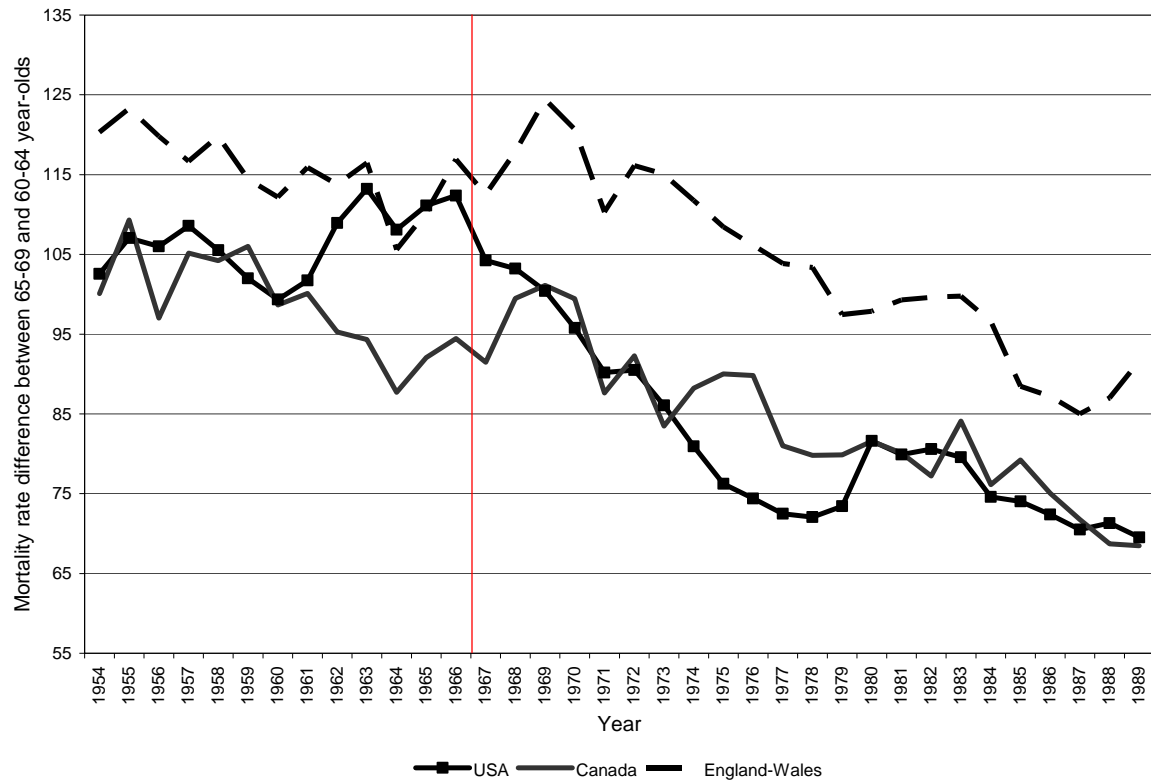
D. Mortality rate differences between 65-69 and 60-64 year olds, by cause of death



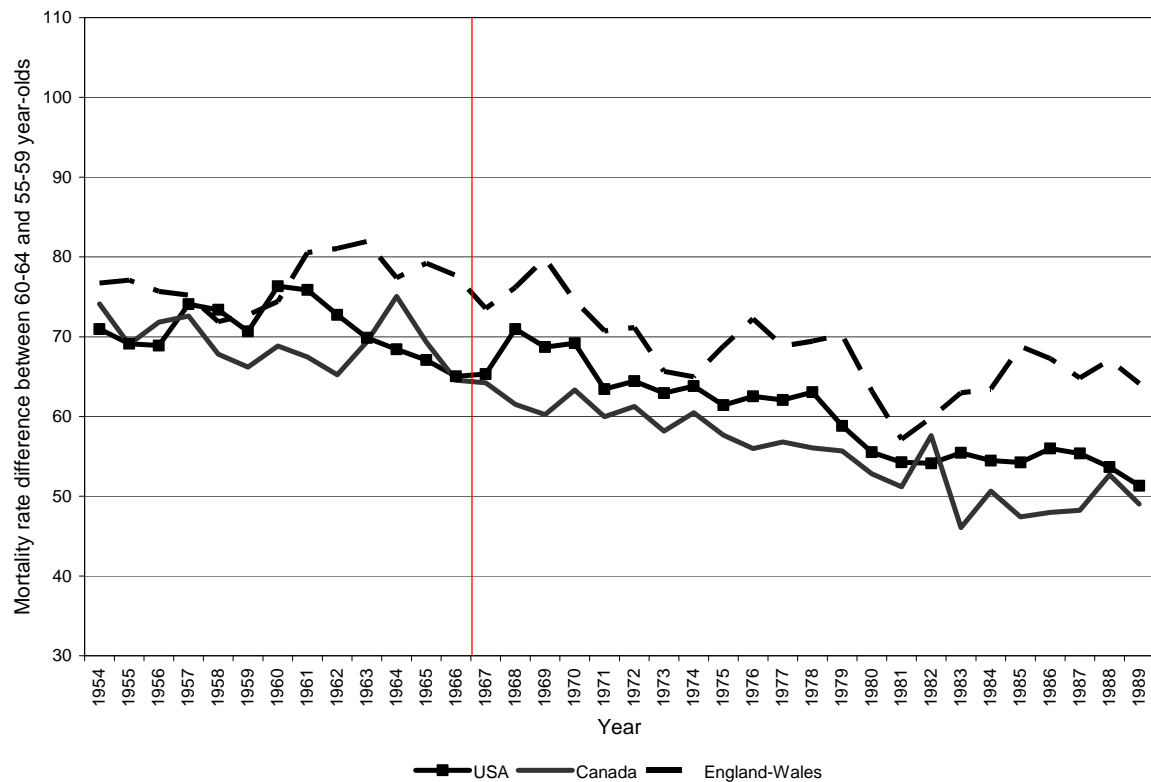
Notes: Data come from the *World Health Organization Mortality Files*. The mortality rates are for the entire United States population – that is, it includes blacks and whites, as well as other races.

Figure 5: Between age-group differences in all-cause mortality rates (per 10,000),
United States, Canada, United Kingdom, France

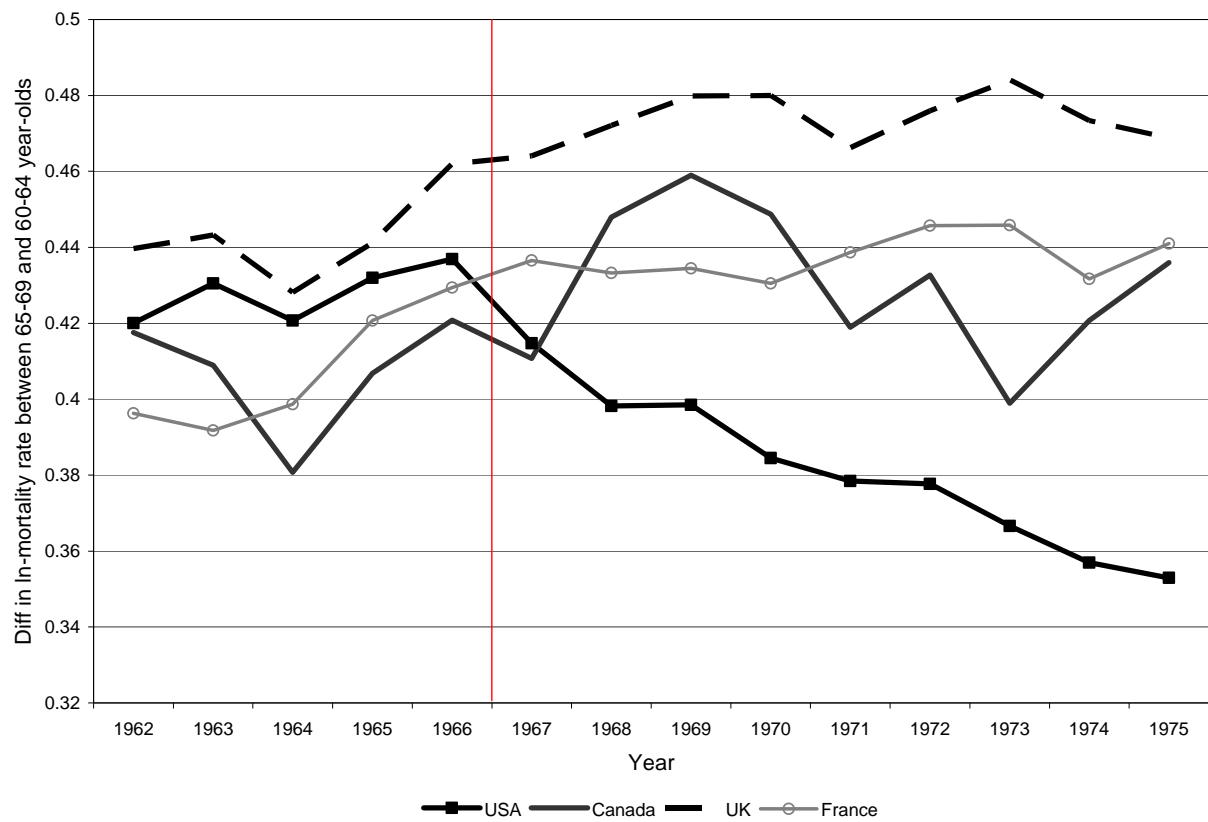
A. Difference in mortality levels between 65-to-69 and 60-to-64 year olds



B. Difference in mortality levels between 60-to-64 and 55-to-59 year olds



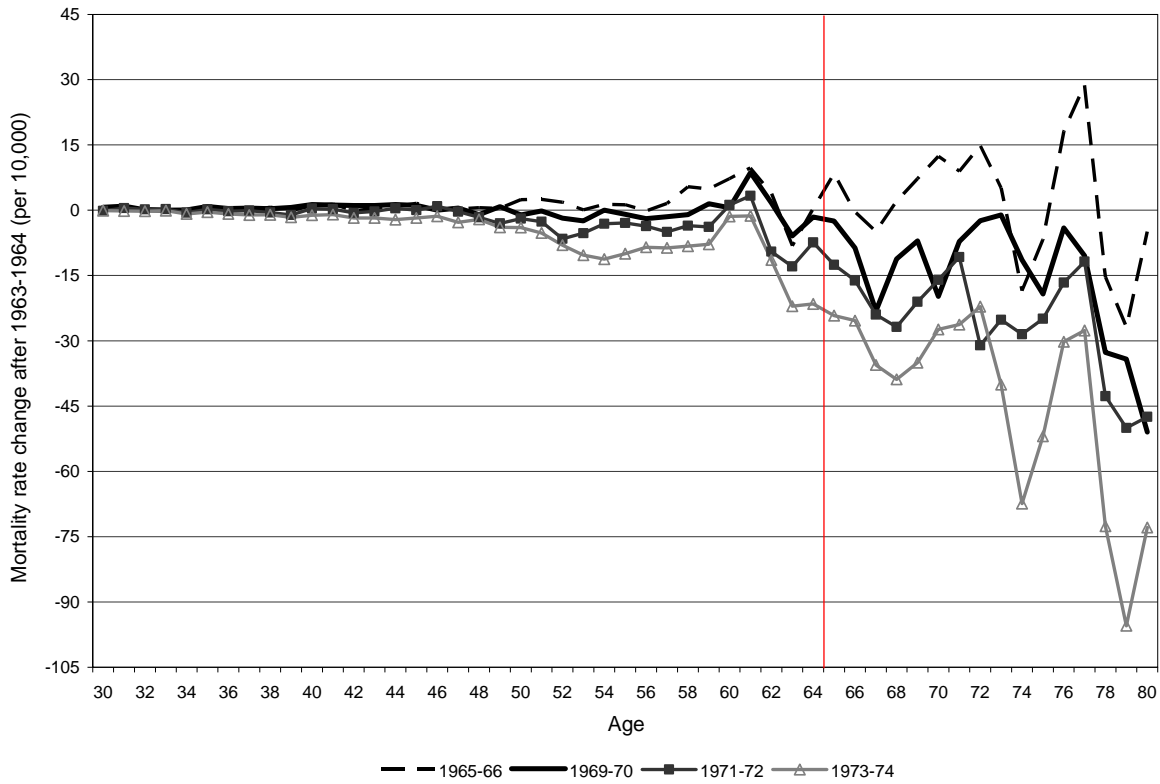
C. Difference in log-mortality between 65-to-69 and 60-to-64 year olds



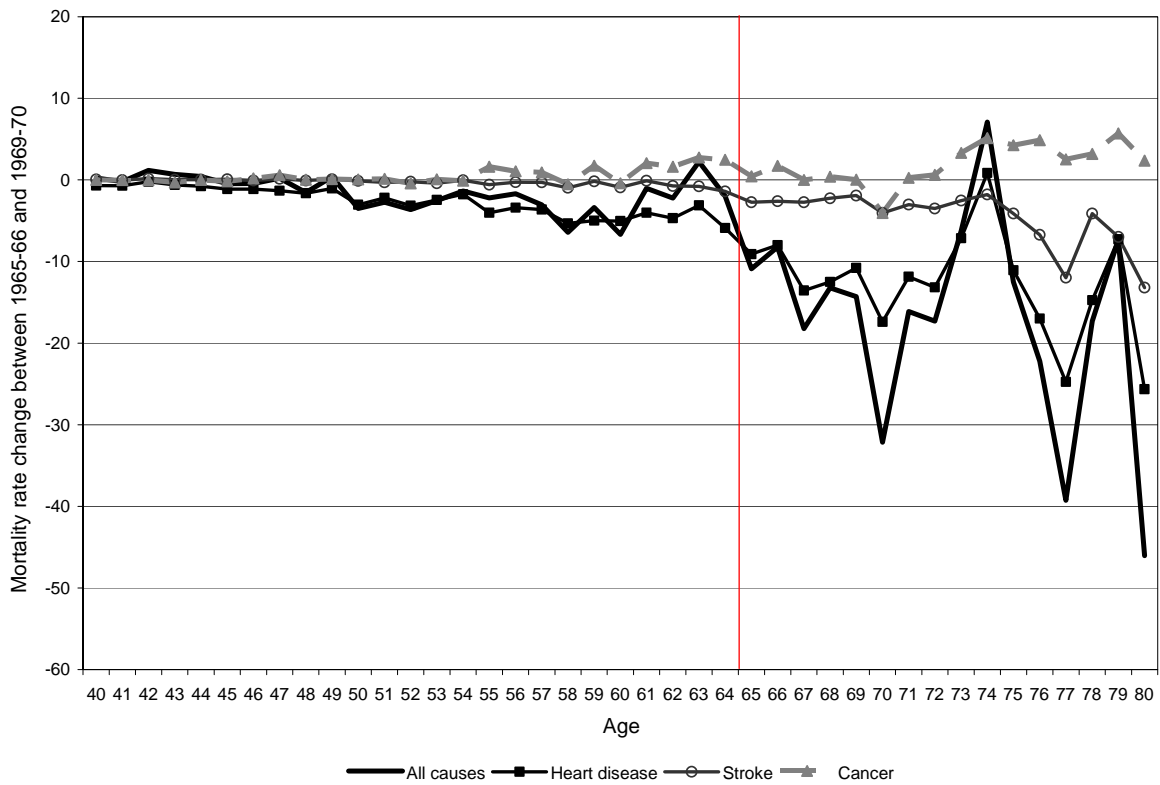
Notes: Data come from the *World Health Organization Mortality Files*.

Figure 6: Mortality rate changes by age and year, Whites only

A. Change in all-causes mortality rates relative to 1963-1964



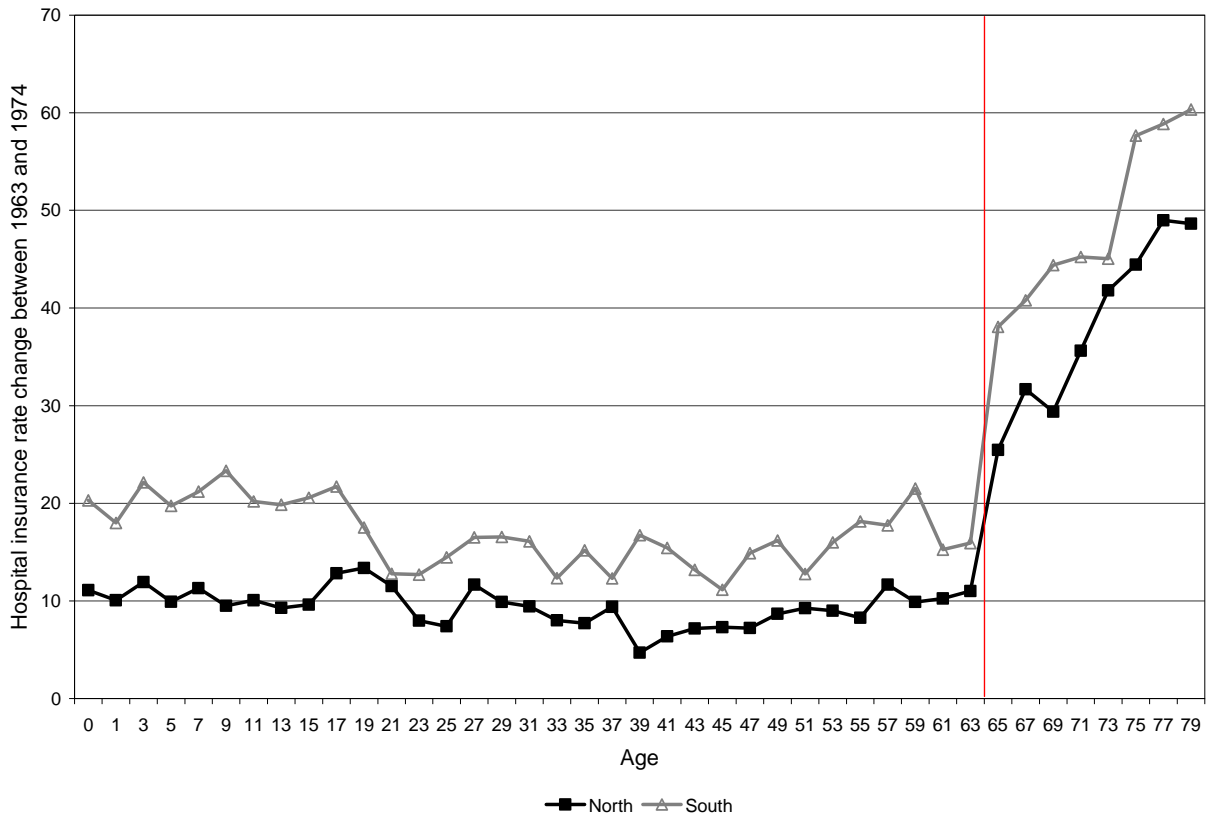
B. Change in mortality rate between 1965-1966 and 1969-1970, by cause of death



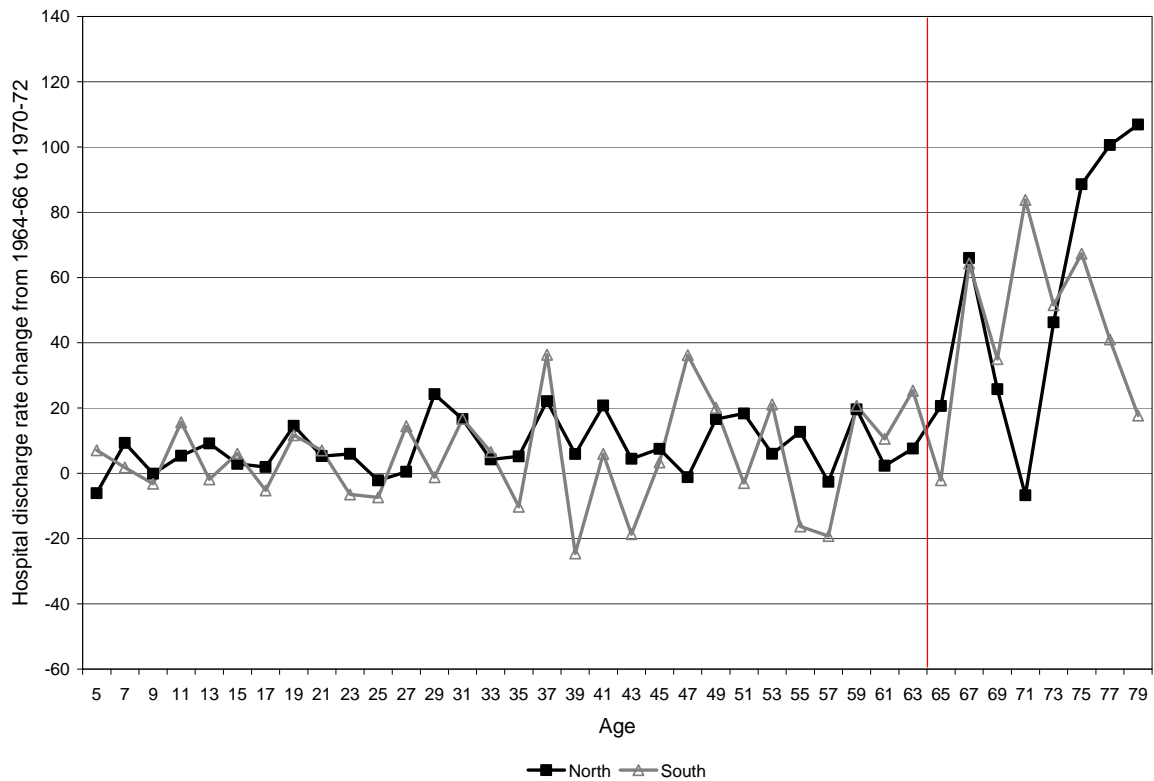
Notes: Mortality counts come from the *Mortality Detail Files* and age-specific, population sizes come from the (unrevised) *Census* counts.

Figure 7: Growth in hospital insurance and discharge rates in the North and South

A. Growth in hospital insurance for whites between 1963 and 1974, North and South



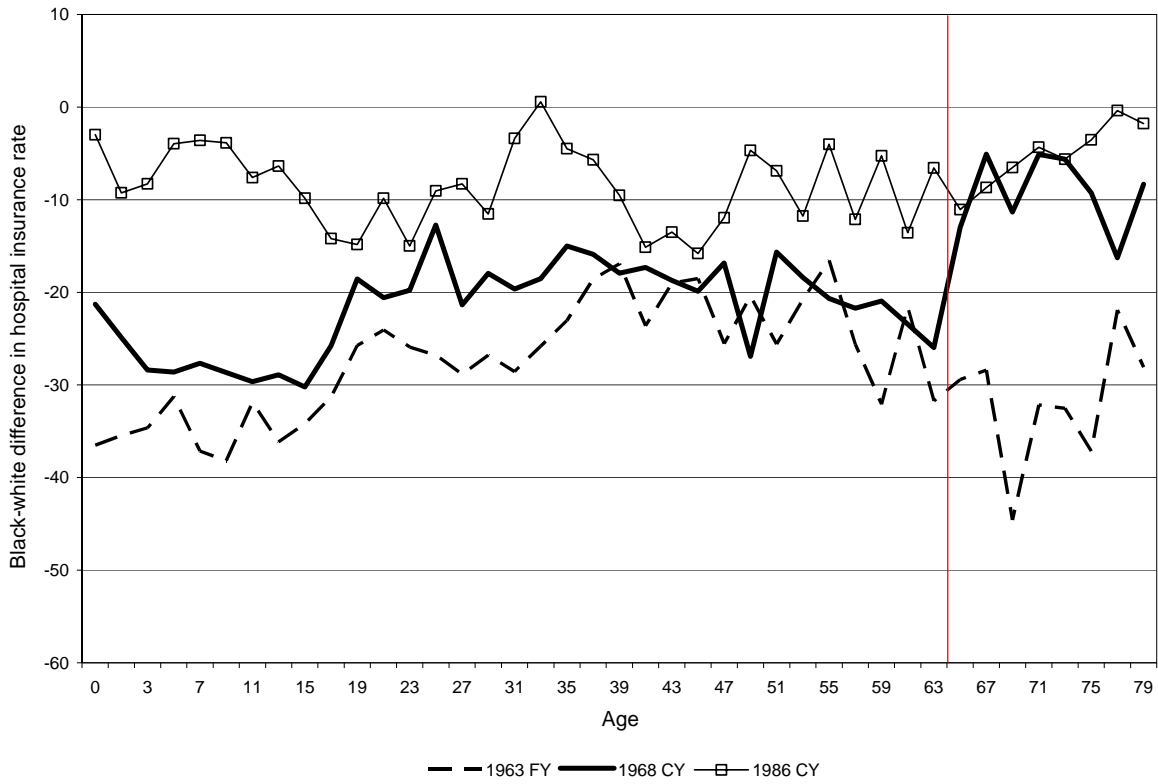
B. Growth in hospital discharge rate between 1964-1966 and 1970-1972, North and South



Notes: Data come from the *National Health Interview Surveys*.

Figure 8: Differentials in hospital insurance rates across time

A. Black-white difference in percent with hospital insurance



B. Insurance rate gap between persons with and without activity limitations (due to chronic conditions)

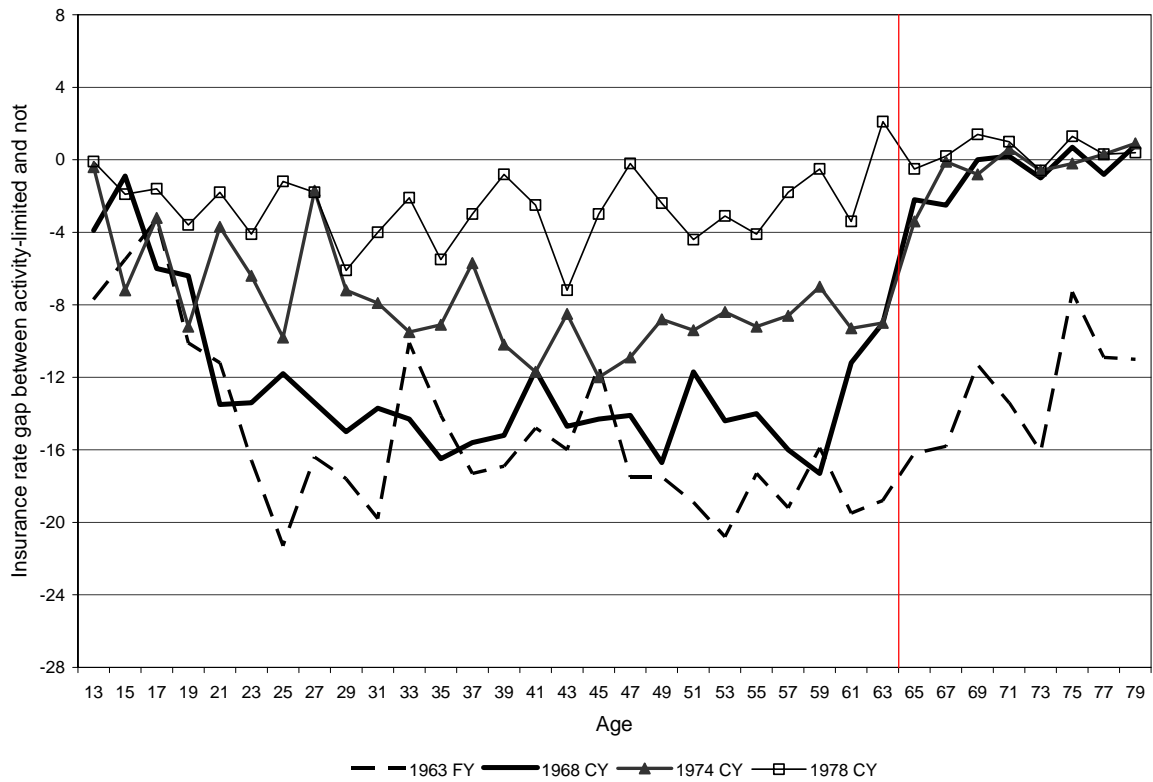
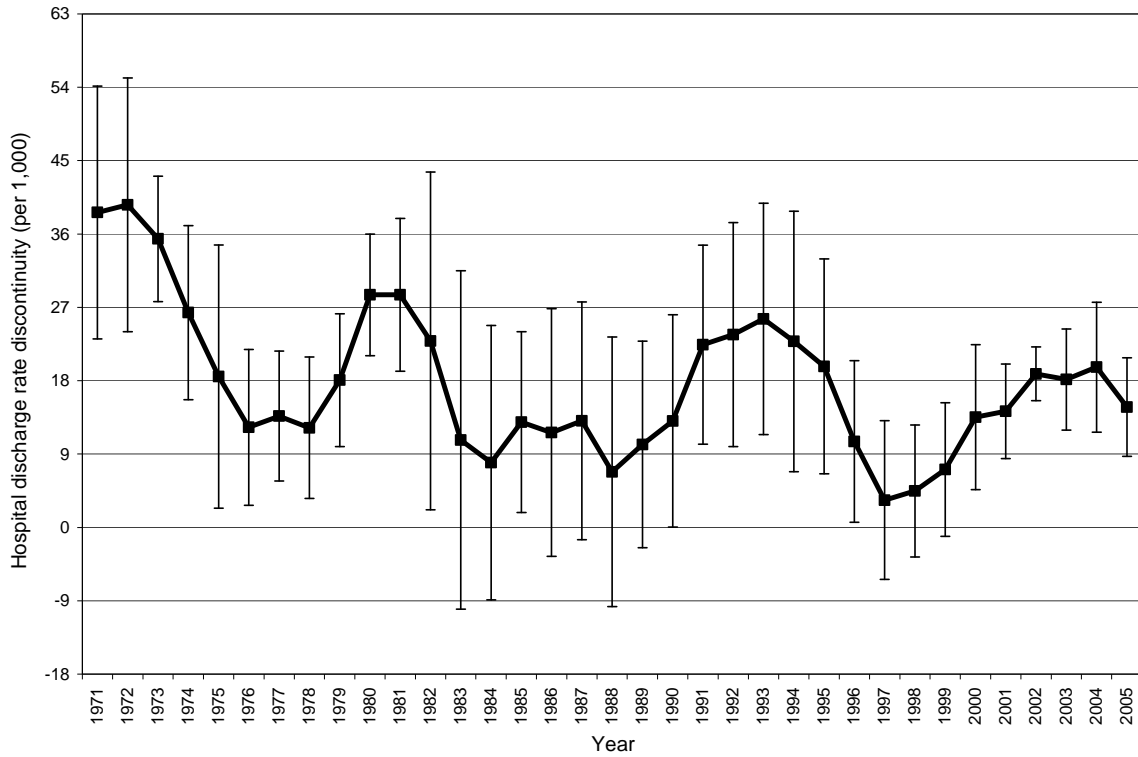
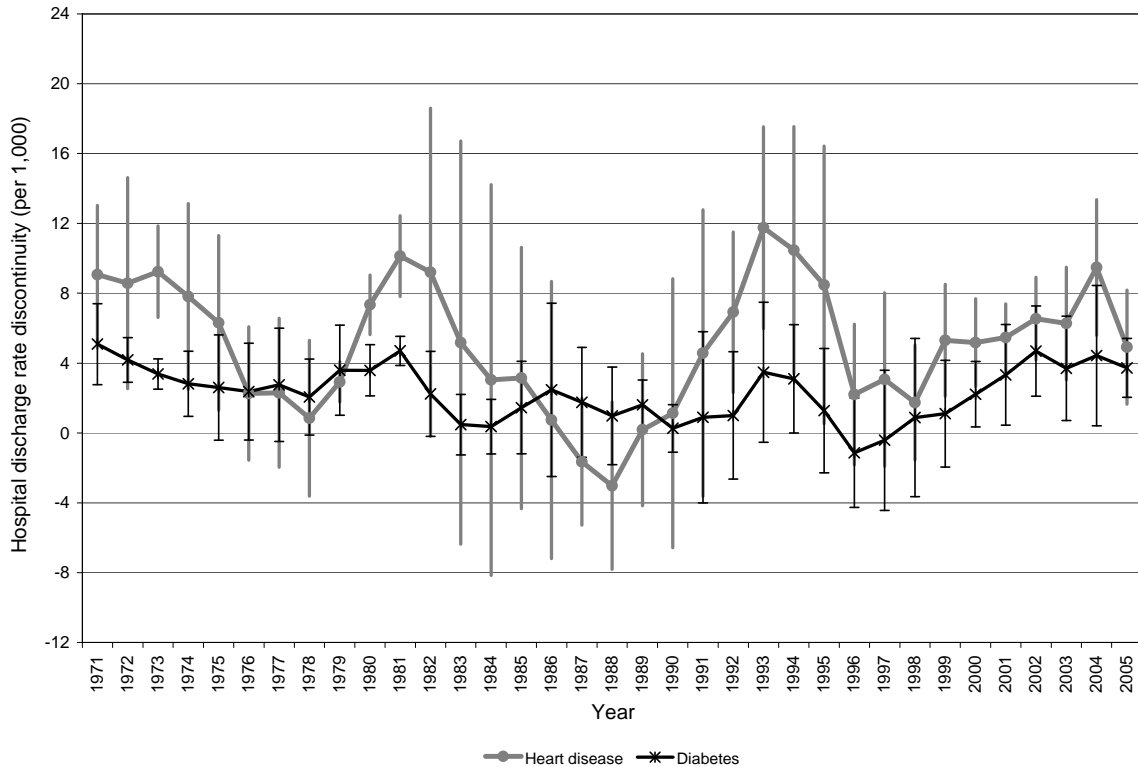


Figure 9: Hospital discharge rate discontinuities at age-65 based on *NHDS*

A. All hospital discharges



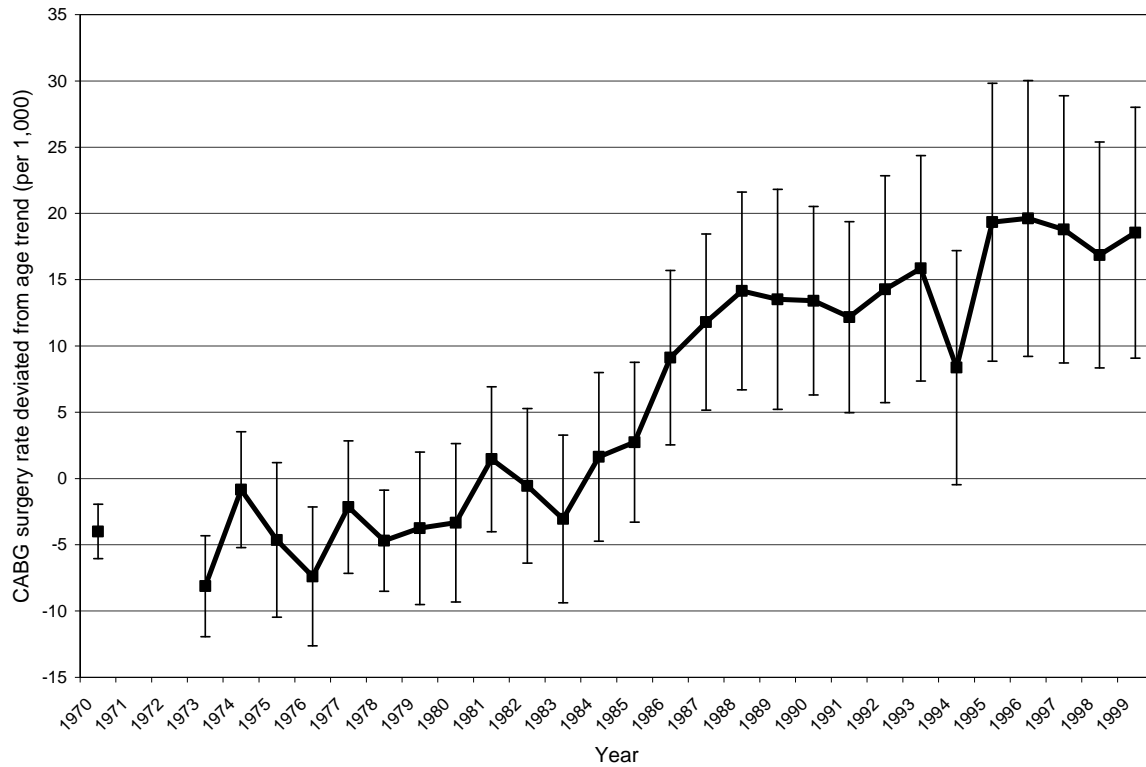
B. Heart disease and diabetes discharges



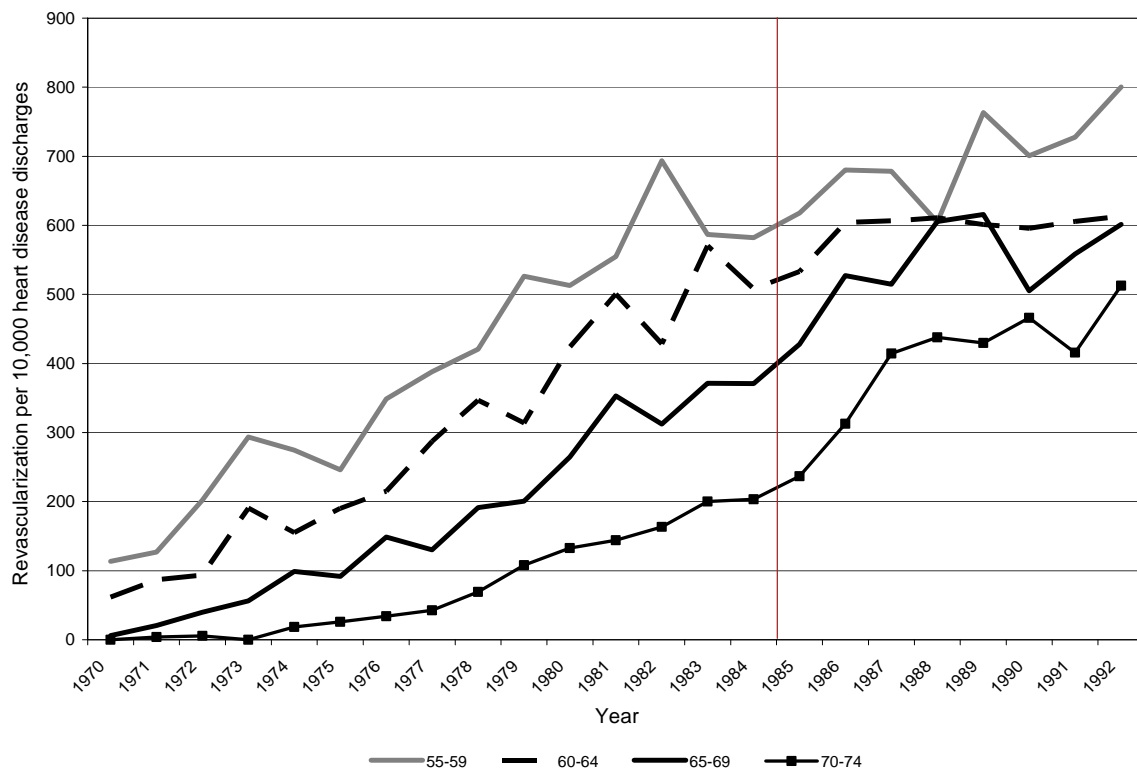
Notes: Data are from the *National Hospital Discharge Surveys* merged to population counts. Discharge rates are the number of admissions divided by the population for each year-age cell. Plots are of the estimated coefficient on an indicator for being aged 65-69 based on regressions for 50 to 69 year-olds with a quartic polynomial in age and using a moving sample of three years (with time effects). Regressions are weighted by cell population sizes and the $(\pm) 2*s.e.$ bands shown have been corrected for age-level clustering and heteroskedasticity.

Figure 10: Age 65-and-over discontinuity in coronary artery bypass graft (CABG) surgery rate, Among hospital discharges

A. Age 65-and-over CABG discontinuity deviated from age trend (ages 50-and-over)

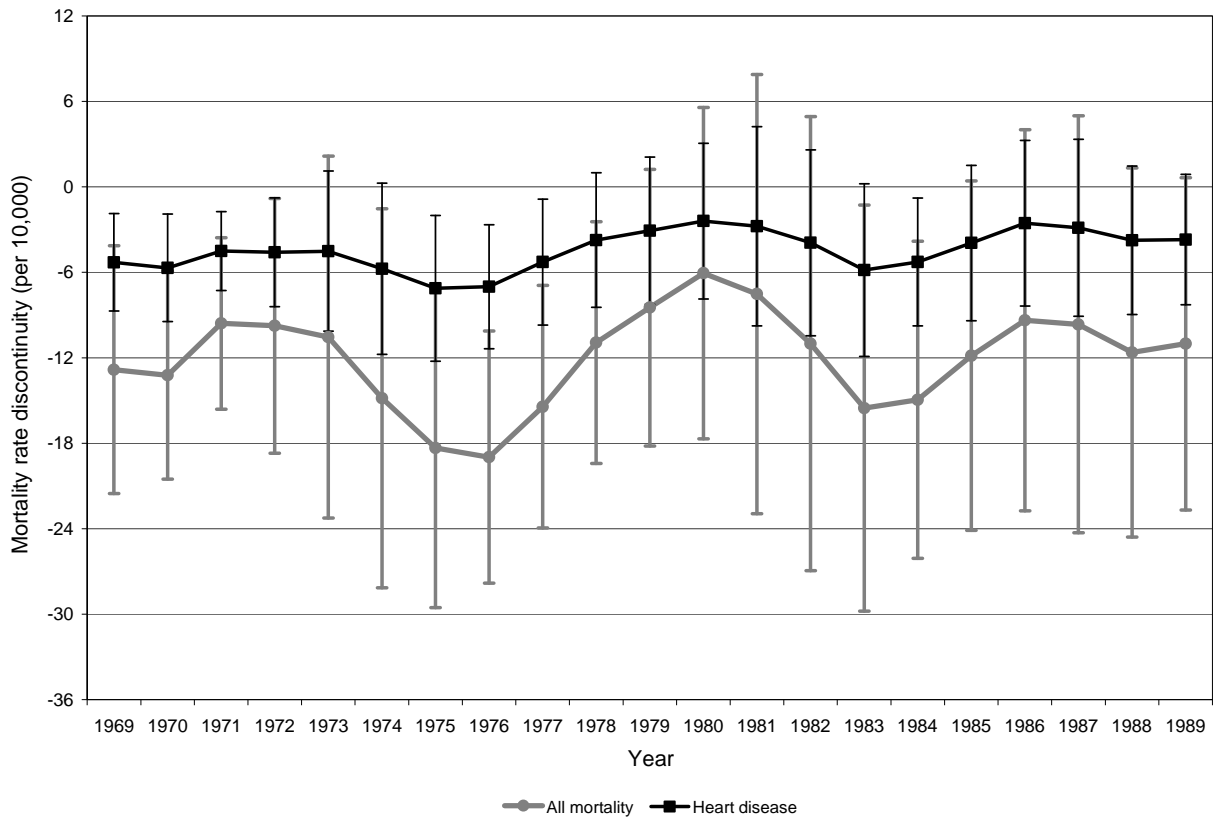


B. CABG rates for heart disease discharges, by age group and over time



Notes: Data come from the *National Hospital Discharge Surveys*. Results are from year-specific, linear probability regressions that include age trends and use samples of discharges aged 50 and over. Vertical lines in Panel A represent (\pm) twice the standard error of the estimate, corrected for heteroskedasticity.

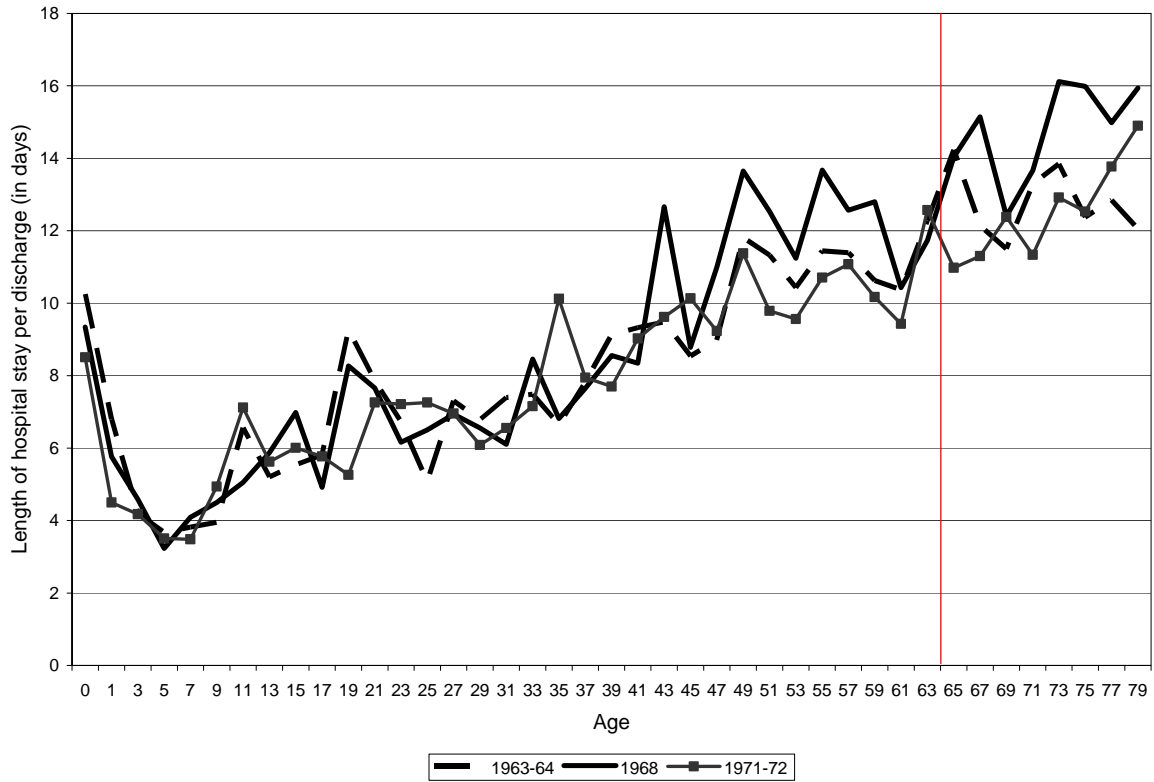
Figure 11: Fractions of hospital discharges for whom primary source of coverage is Medicare or private insurance



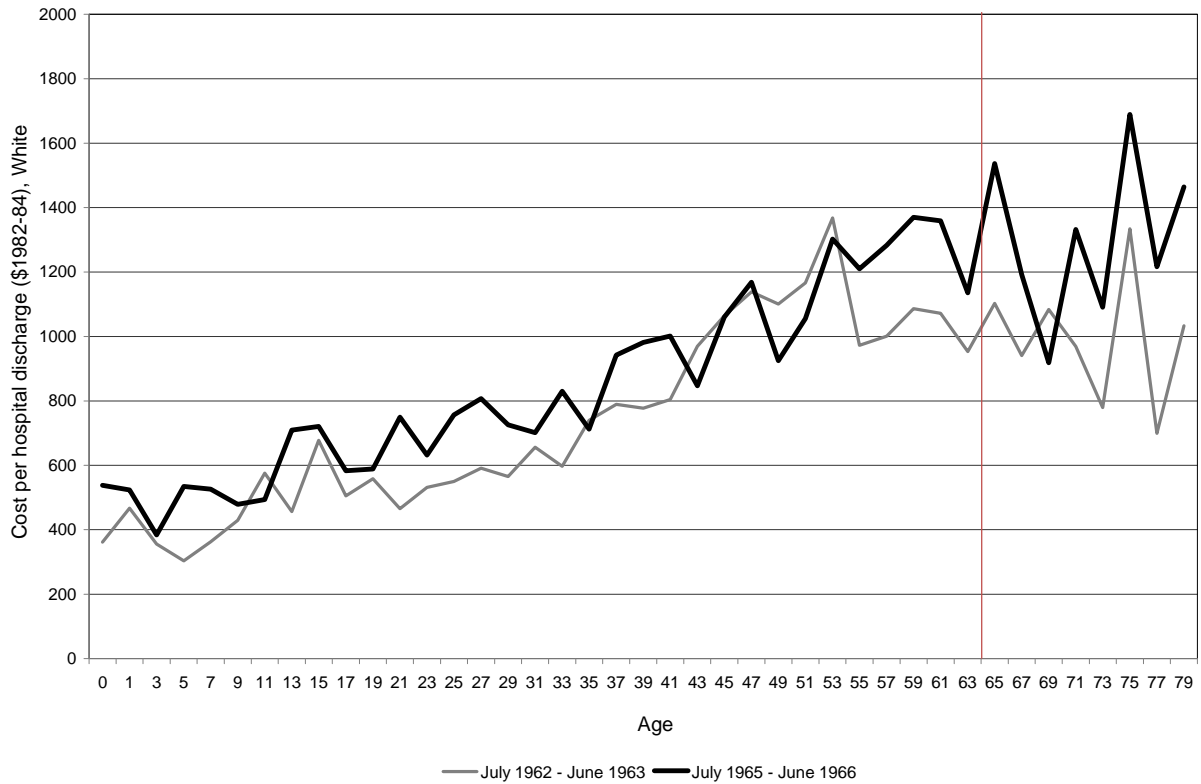
Notes: Data come from the *Mortality Detail Files* merged to population counts. The regressions that generate the plots are based on age-specific mortality rates for 50 to 69 year-olds, and estimate the change in the age-65 discontinuity relative to the baseline period of 1964 to 1966. Each regression contains six years of data (3 years baseline, 3 years after Medicare) and includes time effects, a quartic polynomial in age, and a cubic polynomial in age interacted with an indicator for post-Medicare years. Thus, each point represents a moving average of three years. Regressions are weighted by cell population sizes and the $(\pm) 2*s.e.$ bands shown have been corrected for age-level clustering and heteroskedasticity.

Figure A1: Length-of-stay and Costs per hospital discharge for whites, by year and age

A. Average length-of-stay (in days) per hospital discharge

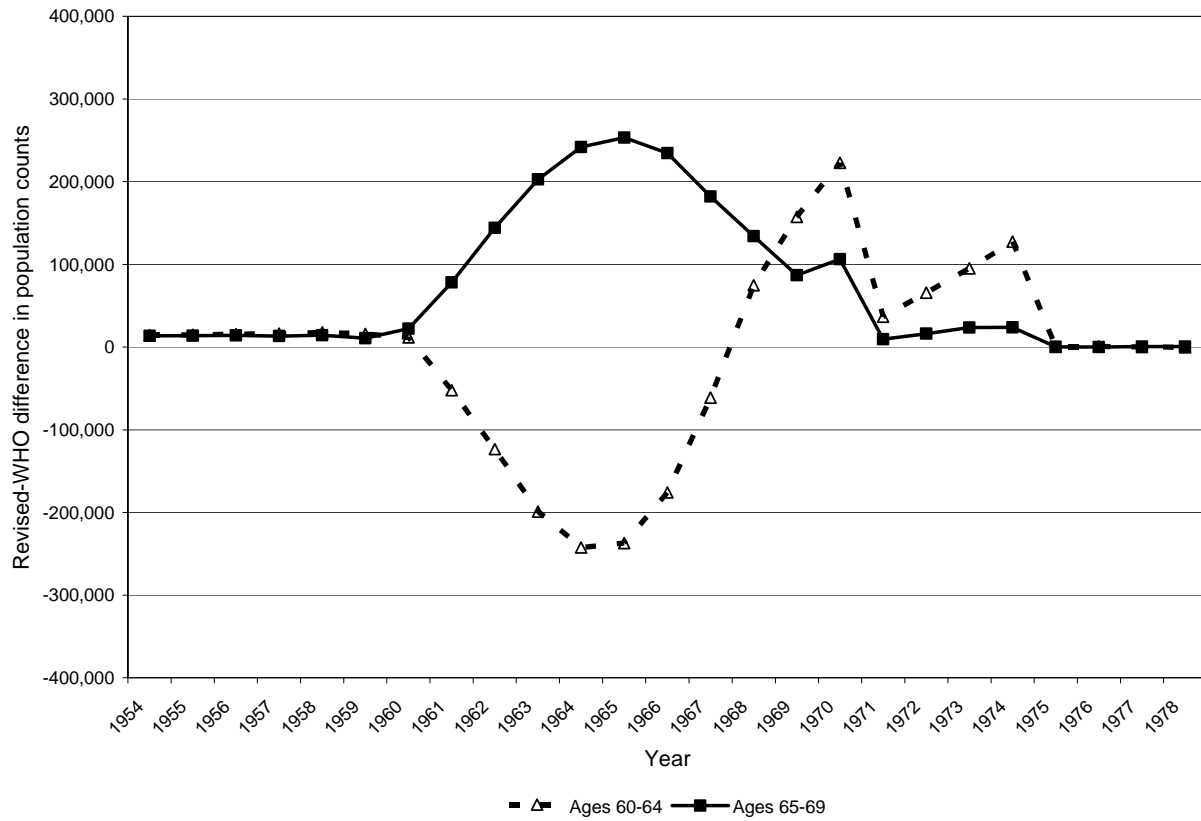


B. Average costs (in 1982-1984 dollars) per hospital discharge (change to all races)



Notes: Data come from the *National Health Interview Surveys*.

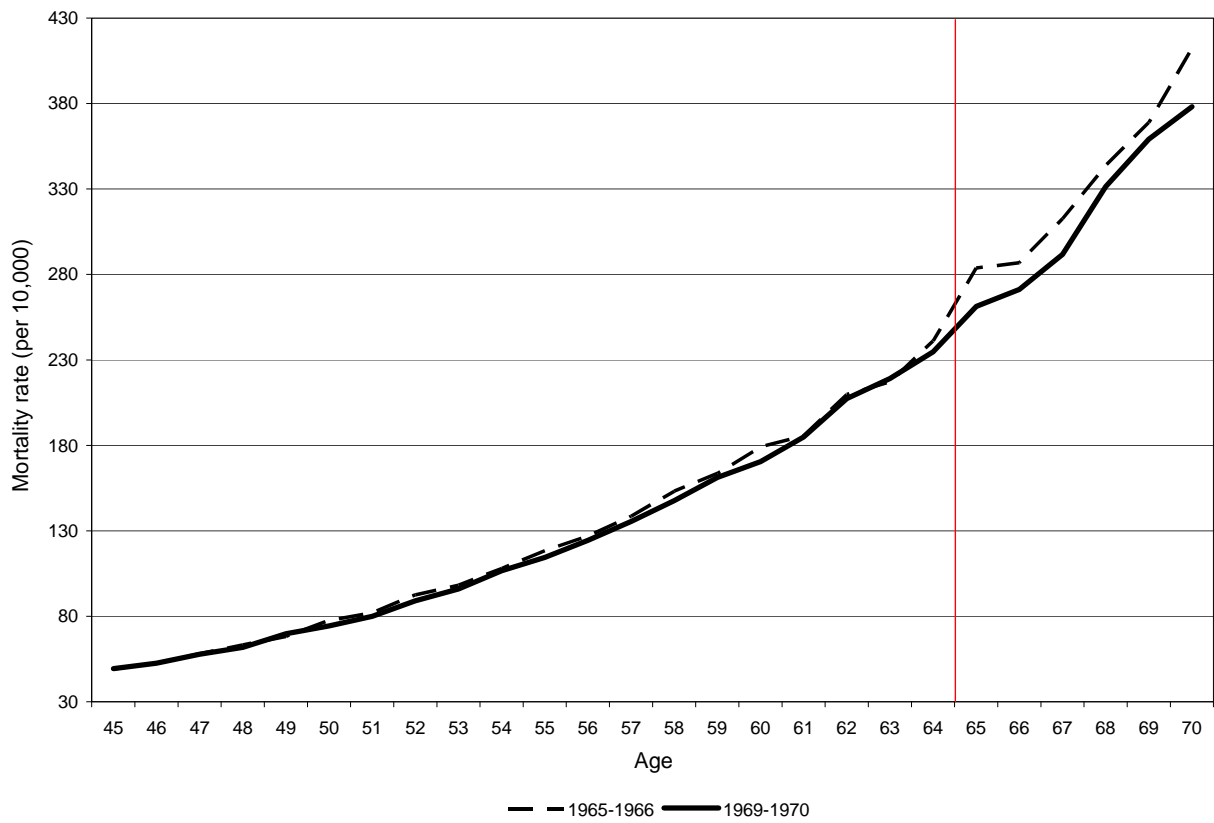
Figure A2: Difference between Intercensal (Revised) and WHO population counts



Notes: Data come from U.S. Census Bureau (Intercensal counts) and World Health Organization (WHO) mortality database.

Figure A3: All-cause mortality rates by age, 1965-1966 and 1969-1970

A. All races



B. Whites only

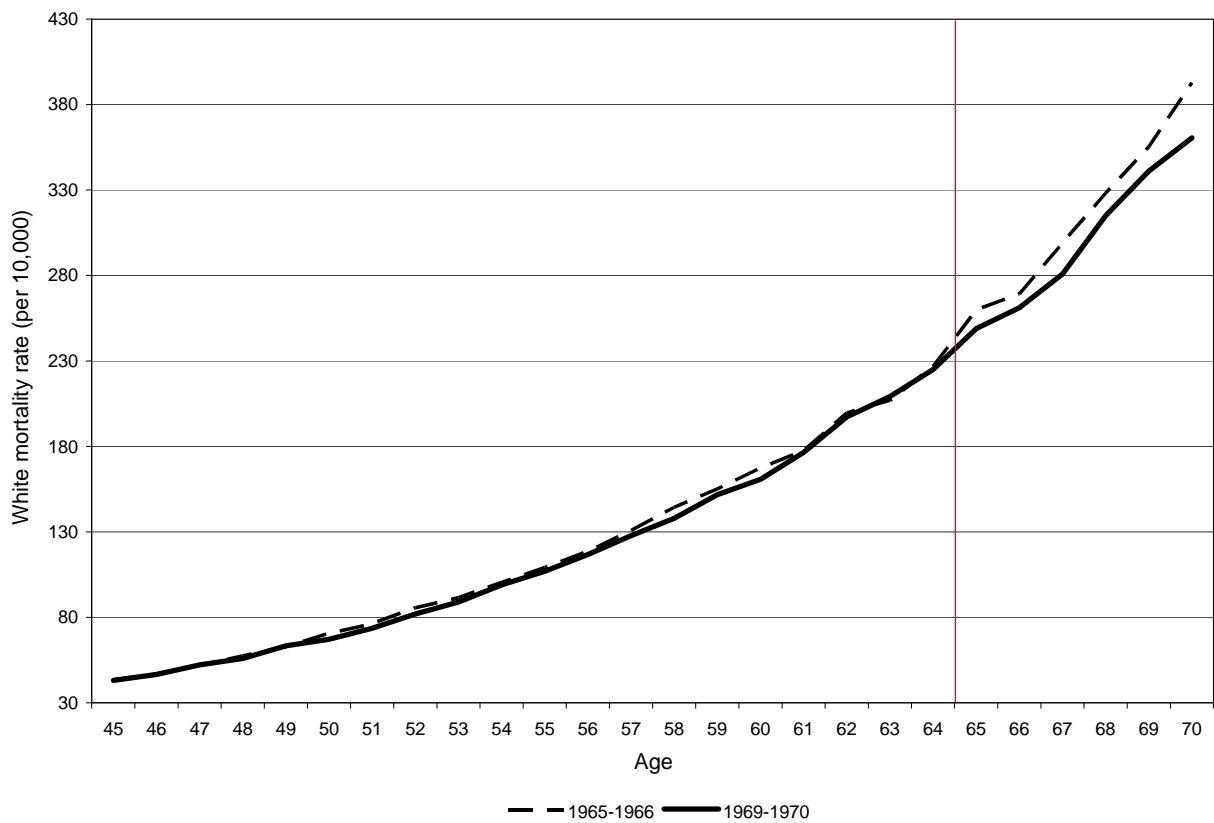
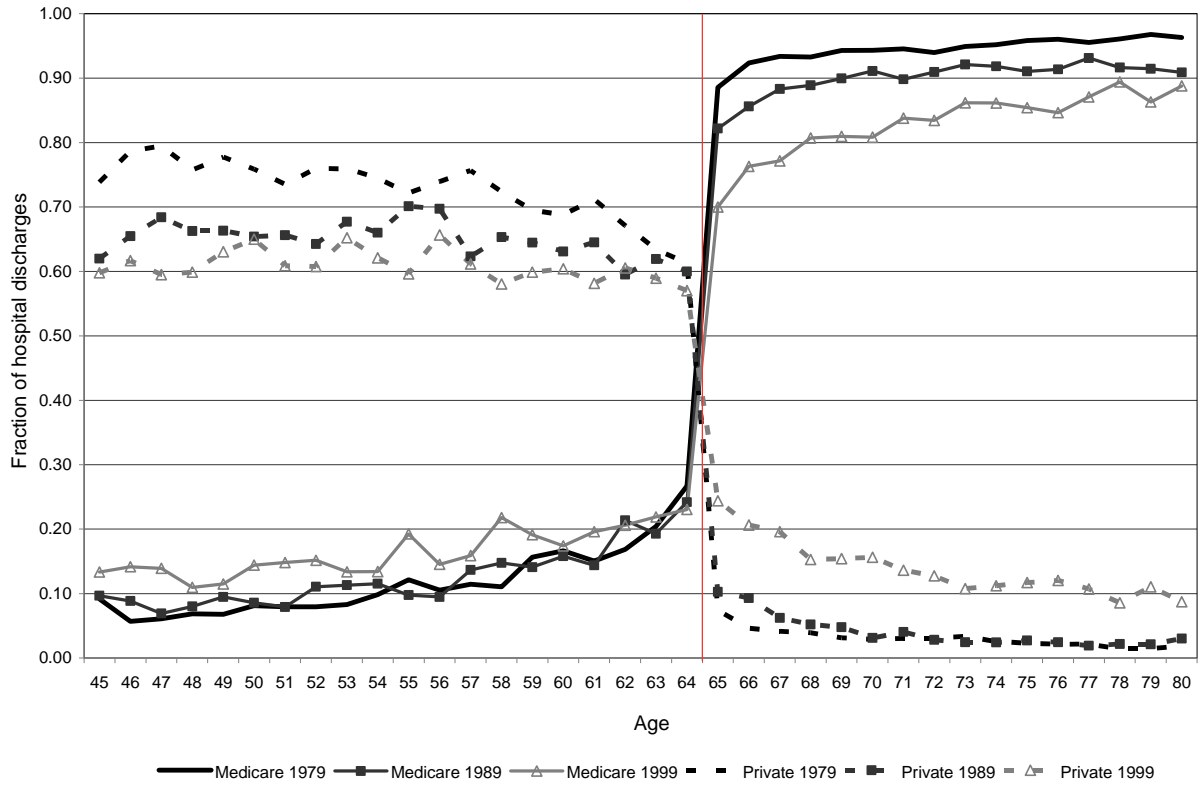


Figure A4: Fractions of hospital discharges for whom primary source of coverage is Medicare or private insurance



Notes: Data come from the *National Hospital Discharge Surveys*.