Association between Education and Health over the Life Cycle

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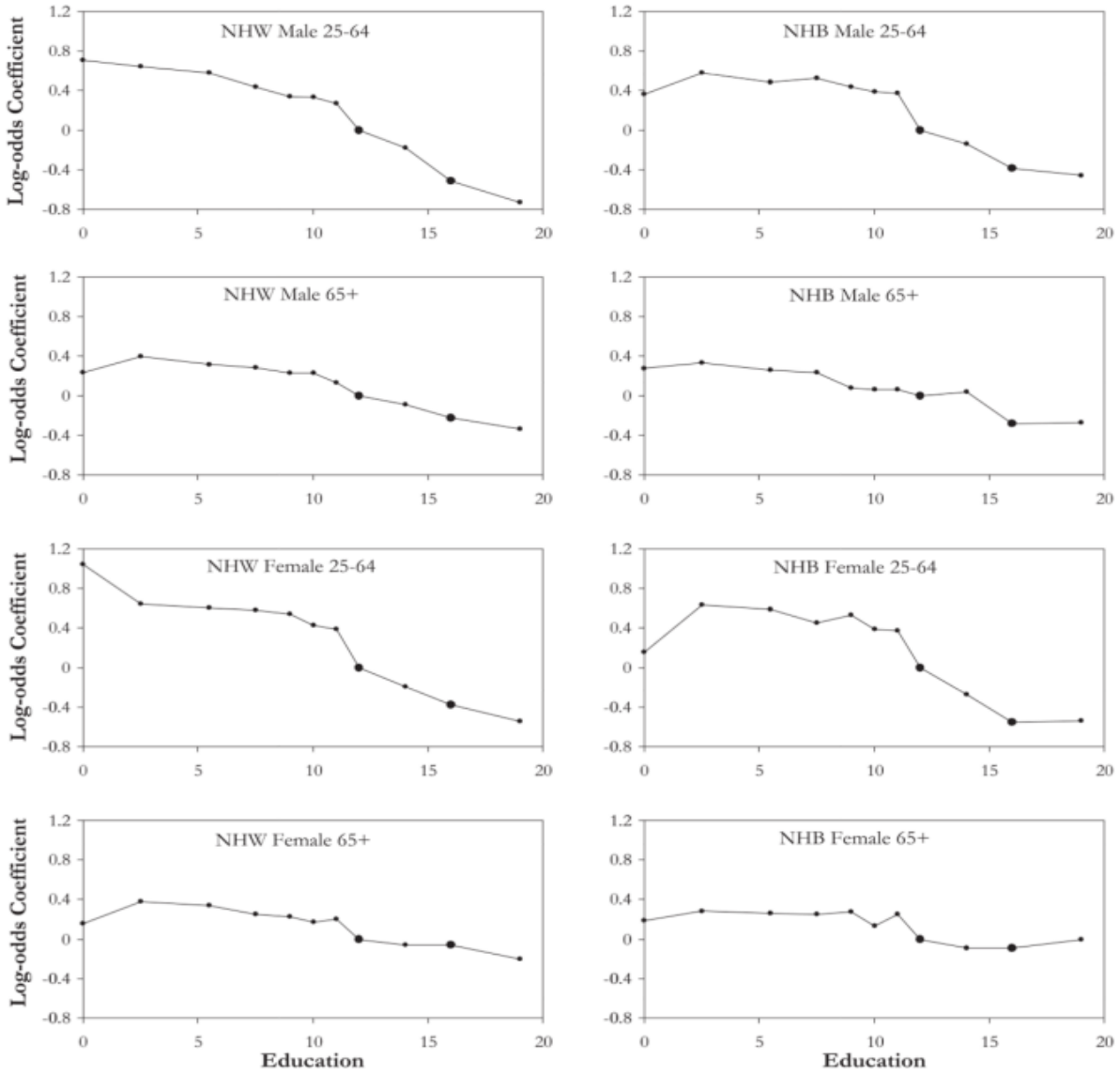
This article was written to honor Michael Grossman, my teacher and friend for 30 years. In keeping with Mike's deeply held belief about the intrinsic value of mentoring, two of my students are coauthors (and true collaborators). While I hope I have contributed significantly to these students' and colleagues' professional lives, I will never be able to help them as much as Mike has helped me both professionally and personally. Nevertheless, I have tried to follow his example. As to the intellectual merit of this article, we can only hope that it adds something to Mike's substantial scholarly contributions, but based on my track record to date, I am not confident that we have been able to do so.

Education and Health Are Positively Related
Montez et al. 2012 *Demography*



Education and Health Are Positively Related

The positive relationship between health and education is well documented (Grossman 2015, 2006).

But how does this relationship change over the life cycle?

How do we expect it to change?

How does it change over time (by birth cohort)? If it does, then why?

There is some research that provides information to answer these questions, but it is limited in significant ways.

What Do We Do?

We start with canonical model of the demand for health and highlight the key role that the depreciation of health capital plays and how that aspect of the model applies to the age-education profile

Then we use the health production function of human capital (life course) model of demand for health and to clarify the interpretation of the effect of education over the life cycle

This conceptual model highlights that the relationship between education and health is dynamic over the life course—education potentially affects health at every age, at some ages, or at no age.

For example, the view that education has cumulative effects on health and that educational differences in health grow with age (cumulative advantage hypothesis in sociology) is consistent with this model, but only if education raises health at most ages.

What Do We Do?

The novel aspect of our analysis is that we measure the effect of education on health at each age by the change in health between ages, which is something that has not been widely recognized

We differentiate between physical health and mental health and how the role of depreciation of health may differ for these outcomes over the life cycle.

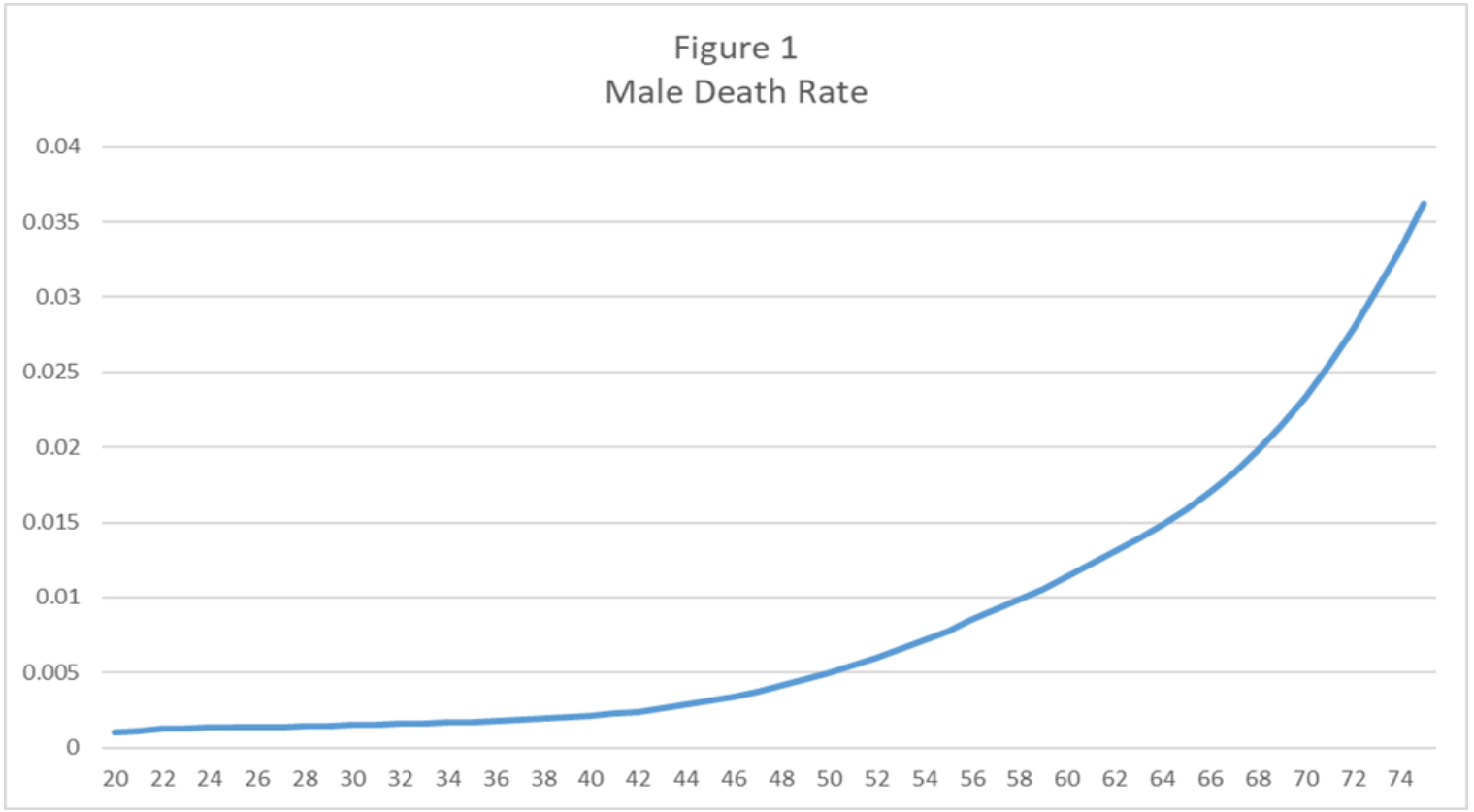
We measure the “age-profile” of education effects for several birth cohorts over a large age range

We present these “age-profiles” and discuss the implications of our finding

Why is age important?

The biological and clinical processes that influence health differ by age and may shape how education affects health.

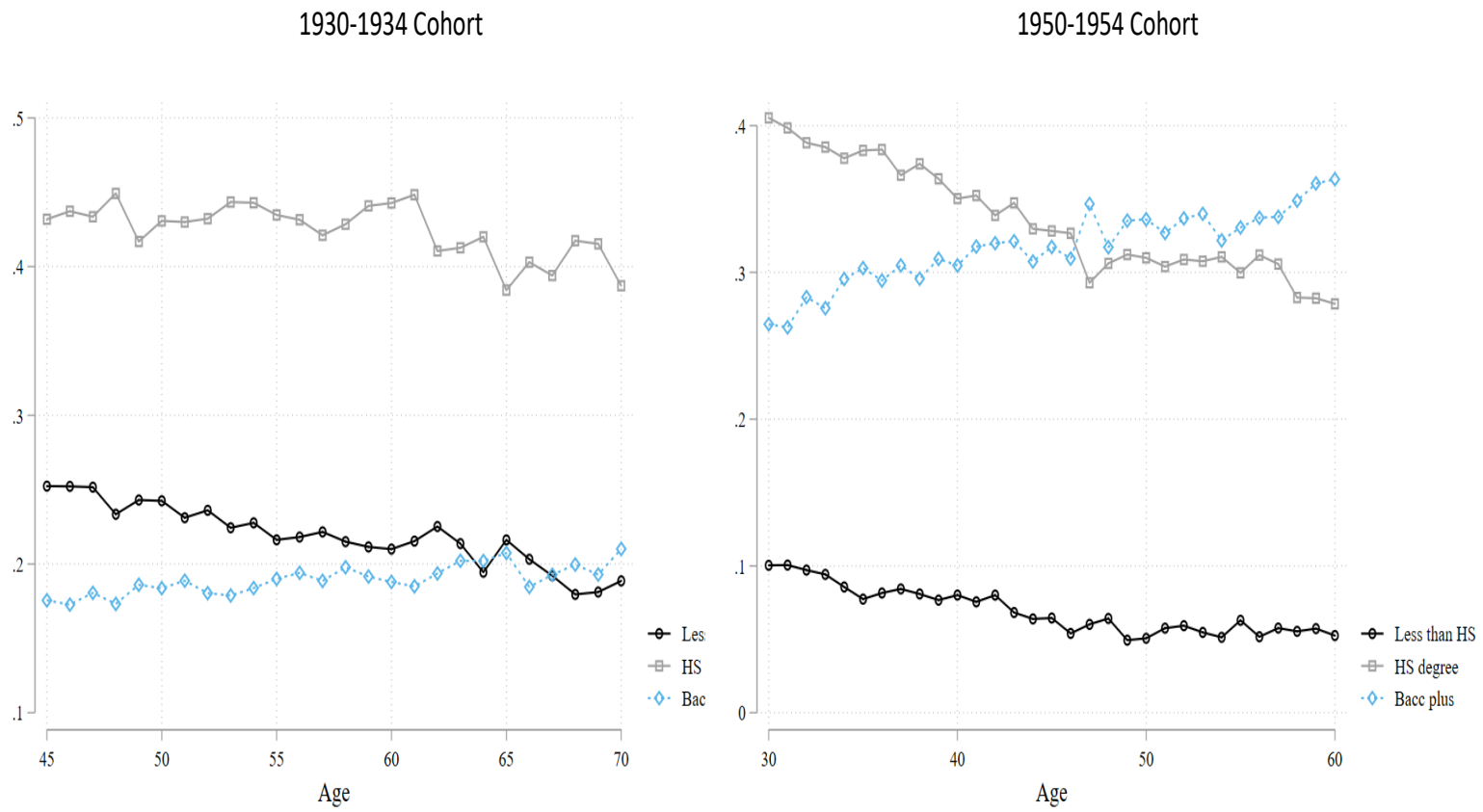
Selective mortality by age can confound estimates of morbidity among those alive.



Why is birth cohort important?

Education distribution changes markedly across cohorts: BA is 20% for 1930-34 cohort and 35% for 1950-54

Healthcare technology has changed across cohorts and may interact with education to affect health.

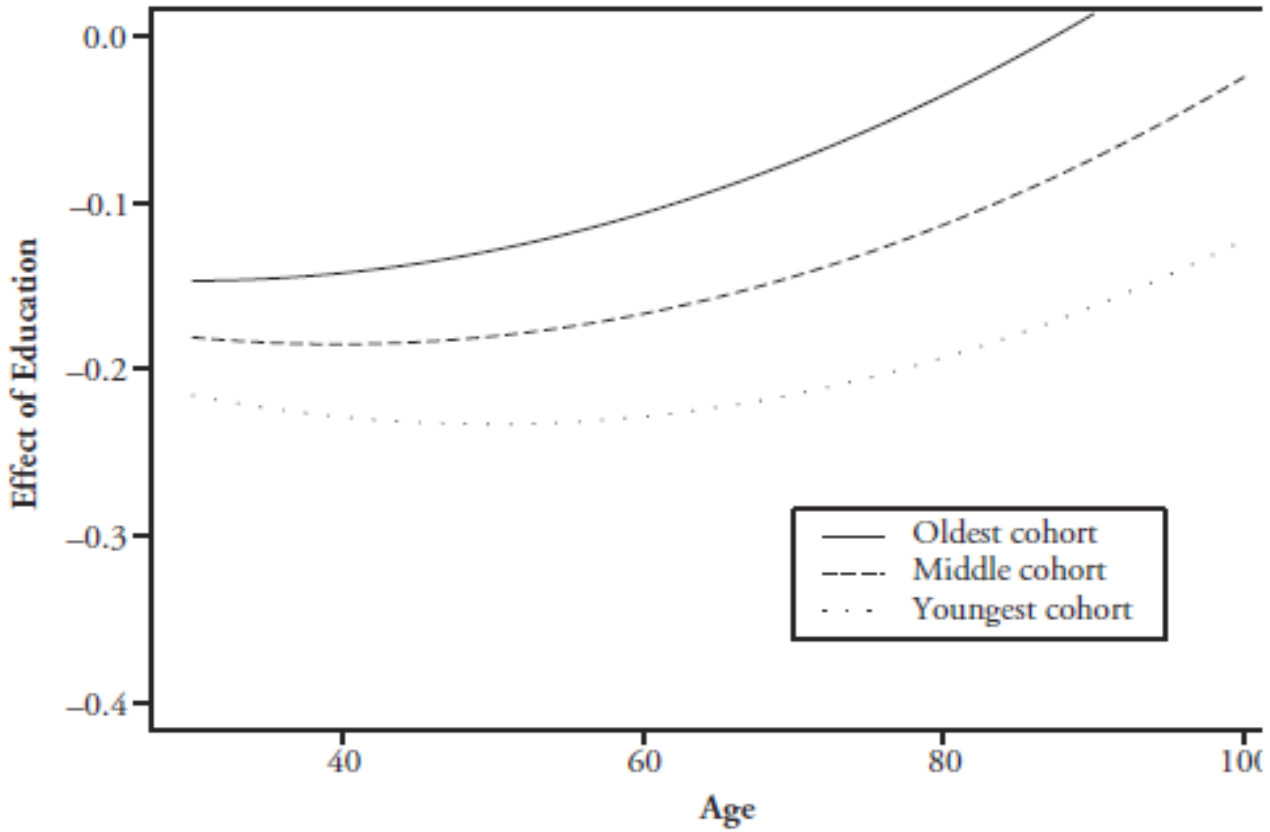


Our Empirical Analysis in Pictures

Our study is most closely related to research that examines the association between education and health over the life course by cohort and age

Lynch 2003 *Demography*

Figure 2. Plot of the Effect of Education Across Age by Cohort: NHIS Data, 1972–1993



These figures were generated from parametric models that assume a quadratic association

Leopold and Leopold 2018

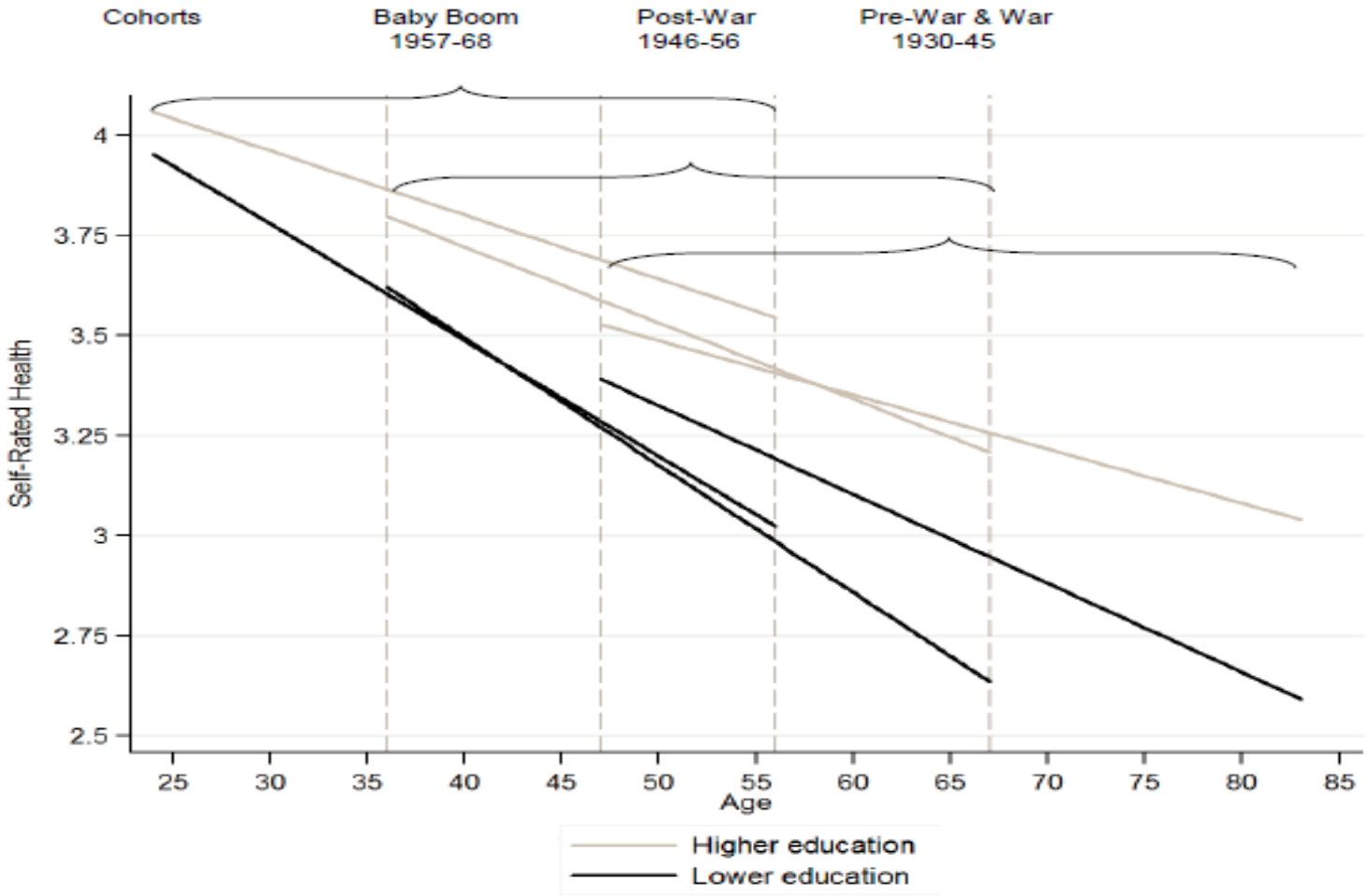
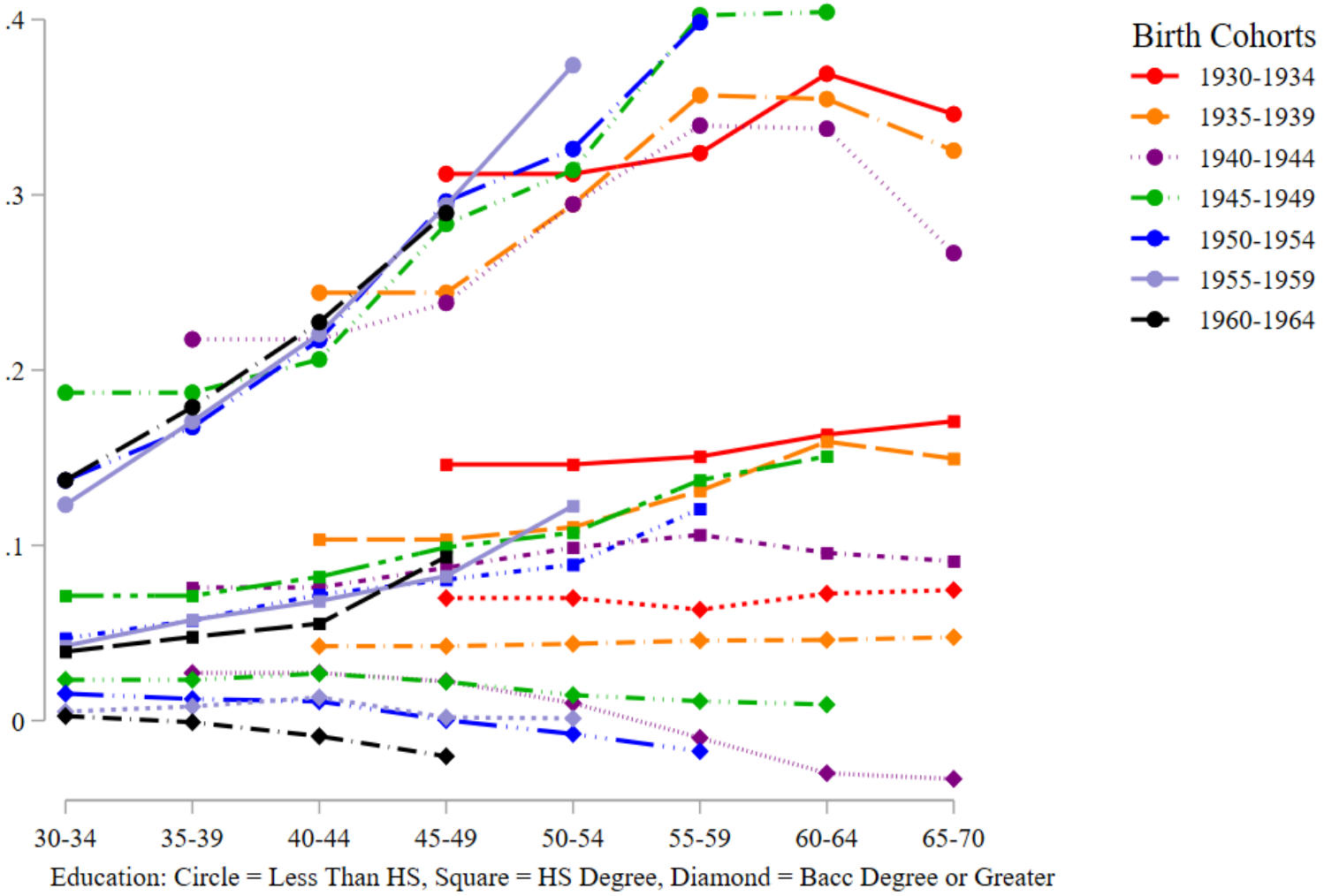


FIGURE 4: PREDICTED TRAJECTORIES OF SELF-RATED HEALTH IN THREE COHORTS OF MEN

These figures were generated from parametric models that assume a linear association

We Estimate Non-parametric Associations
E.g., Self-rated Poor Health Outcome



The behavioral model: Grossman (2000), Galama (2017)

$$\frac{MU_H}{MU_\lambda} + \frac{\partial Y}{\partial H} = MC_I(\delta_t + r) - \frac{\partial MC_I}{\partial t}$$

- This is the first order condition for investment (I) in health (H)
- Left Hand Side is marginal benefit:
  - ratio of marginal utility of health to wealth
  - plus the effect of health on income
- Right Hand Side is marginal cost:
  - marginal cost (MC) of investment is ratio of price to marginal product of investment at producing health
  - user cost of capital equal to depreciation rate and interest rate
  - change in marginal cost over time

The behavioral model: Grossman (2000), Galama (2017)

$$\frac{MU_H}{MU_\lambda} + \frac{\partial Y}{\partial H} = MC_I(\delta_t + r) - \frac{\partial MC_I}{\partial t}$$

- The depreciation rate is a key aspect of model for how investment and thus health change over the life cycle
- **Grossman (2000):**
  - if depreciation is zero, and there is no inflation (change in MC), then there is no investment at that age and health remains constant
  - So, during certain periods of life, for example, while young, depreciation is zero and there will be no investment and no change in health
  - If depreciation increases with age, then investment is positive and health will change, for example, decrease more slowly than the rate of biological change

The behavioral model: Grossman (2000), Galama (2017)

$$\frac{MU_H}{MU_\lambda} + \frac{\partial Y}{\partial H} = MC_I(\delta_t + r) - \frac{\partial MC_I}{\partial t}$$

- The depreciation rate is a key aspect of model for how investment and thus health change over the life cycle
- **Galama (2017):**
  - marginal utility of wealth decreases with age at rate of interest—wealth is less important as one nears end of life
  - if depreciation is zero, and there is no inflation (change in MC), then investment in health increases to raise health (and maintain equilibrium)
  - If depreciation increases with age, then investment is positive and health will change, for example, decrease more slowly than the rate of biological change

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

- The central feature of the Grossman model is the health production function

$$H_t = H_0(1-\delta_0)...(1-\delta_{t-1}) + \alpha I_0(1-\delta_1)...(1-\delta_{t-1}) + \alpha I_1(1-\delta_2)...(1-\delta_{t-1}) + \\ ... + \alpha I_{t-2}(1-\delta_{t-1}) + \alpha I_{t-1}$$

- health at age t is a function of:
- initial health (H_0)
- all past investments in health (I_0, …, I_{t-1})
- and all previous rates of depreciation (δ_0, …, δ_{t-1}).
- **This is not a behavioral model—the life cycle path of investment is determined by the previous behavioral model**

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

- A general way to write the health production function

$$H_t = H_0(1-\delta_0)...(1-\delta_{t-1}) + \alpha_0 I_0(1-\delta_1)...(1-\delta_{t-1}) + ... + \alpha_{(t-1)} I_{t-1}$$

$$H_t = H_0 \prod_{j=k+1}^{t-1}(1-\delta_j) + \alpha_0 I_0 \prod_{j=k+1}^{t-1}(1-\delta_j) + ... + \alpha_{(t-1)} I_{t-1}$$

$$\prod_{j=k+1}^{t-1}(1-\delta_j) = (1-\delta_{k+1})...(1-\delta_{t-1})$$

- The health production function is age-specific.
- **The effect of an investment differs by age—and not just because of longer periods of depreciation**
- **The age-specificity of the health production function suggests that it may be inappropriate to use samples of people of different ages without allowing the effects of investments to differ by age.**

Interpreting the Effect of Education on Health By Age The Human Capital Model of Health Production

- The difference in health at two ages is:

$$H_{t+1} - H_t = \alpha_t I_t - H_0 \delta_t [\prod_{j=k+1}^{t-1} (1-\delta_j)] - \alpha_0 I_0 \delta_t [\prod_{j=k+1}^{t-1} (1-\delta_j)] - \ldots - \alpha_{(t-1)} \delta_t I_{t-1}$$

- The difference in health between two ages depends on the last period's investment (I_t) minus the extra depreciation as a result of being one year older.
- **Behavioral Model Implication (Grossman):**
- **If there is no depreciation, then there is no investment and no change in health**
- **If depreciation is constant with age, then investment is positive and offsets depreciation.**
- **At young ages, it is plausible that there is little depreciation of health. Therefore, there would be little investment and little change in health**

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

- We assume that education influences health by moderating the productivity of investment

- For example, those who are more educated may process information from health providers more efficiently and have better decision making skills.

$$H_t = H_0 \prod_{j=k+1}^{t-1}(1-\delta_j) + \alpha_0 I_0 \prod_{j=k+1}^{t-1}(1-\delta_j) + \ldots + \alpha_{19t}(E) I_{19} \prod_{j=k+1}^{t-1}(1-\delta_j) + \ldots + \alpha_{(t-1)}(E) I_{t-1}$$

- Assume that education is 0 prior to age 18 (or another age, say 25) and is constant thereafter

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

- The effect of education on health is

$$\frac{\partial H_t}{\partial E} = \sum_{k=19}^{t-2} [(\frac{\partial \alpha_k}{\partial E} I_k \prod_{j=k+1}^{t-1} (1-\delta_j)] + \frac{\partial \alpha_{(t-1)}}{\partial E} I_{t-1}$$

- **This is the cumulative effect of education. It measures the sum of the moderating effects of education on investments in health up to age t**
- If education also affects the amount of investment, then:

$$\frac{\partial H_t}{\partial E} = \sum_{k=19}^{t-2} [(\frac{\partial \alpha_k}{\partial E} I_k + \alpha_k \frac{\partial I_k}{\partial E}) \prod_{j=k+1}^{t-1} (1-\delta_j)] + \frac{\partial \alpha_{t-1}}{\partial E} I_{t-1} + \alpha_{t-1} \frac{\partial I_{t-1}}{\partial E}$$

- This effect can be measured by the following regression model

$$H_{it} = \pi_0 + \pi_t EDUCATION_i + e_i$$

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

- The difference in the effect of education on health between ages t+1 and t is

$$\frac{\partial H_{t+1}}{\partial E} - \frac{\partial H_t}{\partial E} = \frac{\partial \alpha_t}{\partial E} I_t - \sum_{k=19}^{t-2} \{[\frac{\partial \alpha_k}{\partial E} I_k \delta_t \prod_{j=k+1}^{t-1} (1-\delta_j)]\} - \delta_t \frac{\partial \alpha_{(t-1)}}{\partial E} I_{t-1}$$

- It is the moderating effect of education on investments in health at age t—this effect may differ for each age

- It can be measured using the following regression

$$H_{i(t+1)} - H_{it} = \tilde{\pi}_0 + \tilde{\pi}_{t+1} EDUCATION_i + (e_{i(t+1)} - e_{it})$$

Interpreting the Effect of Education on Health By Age
The Human Capital Model of Health Production

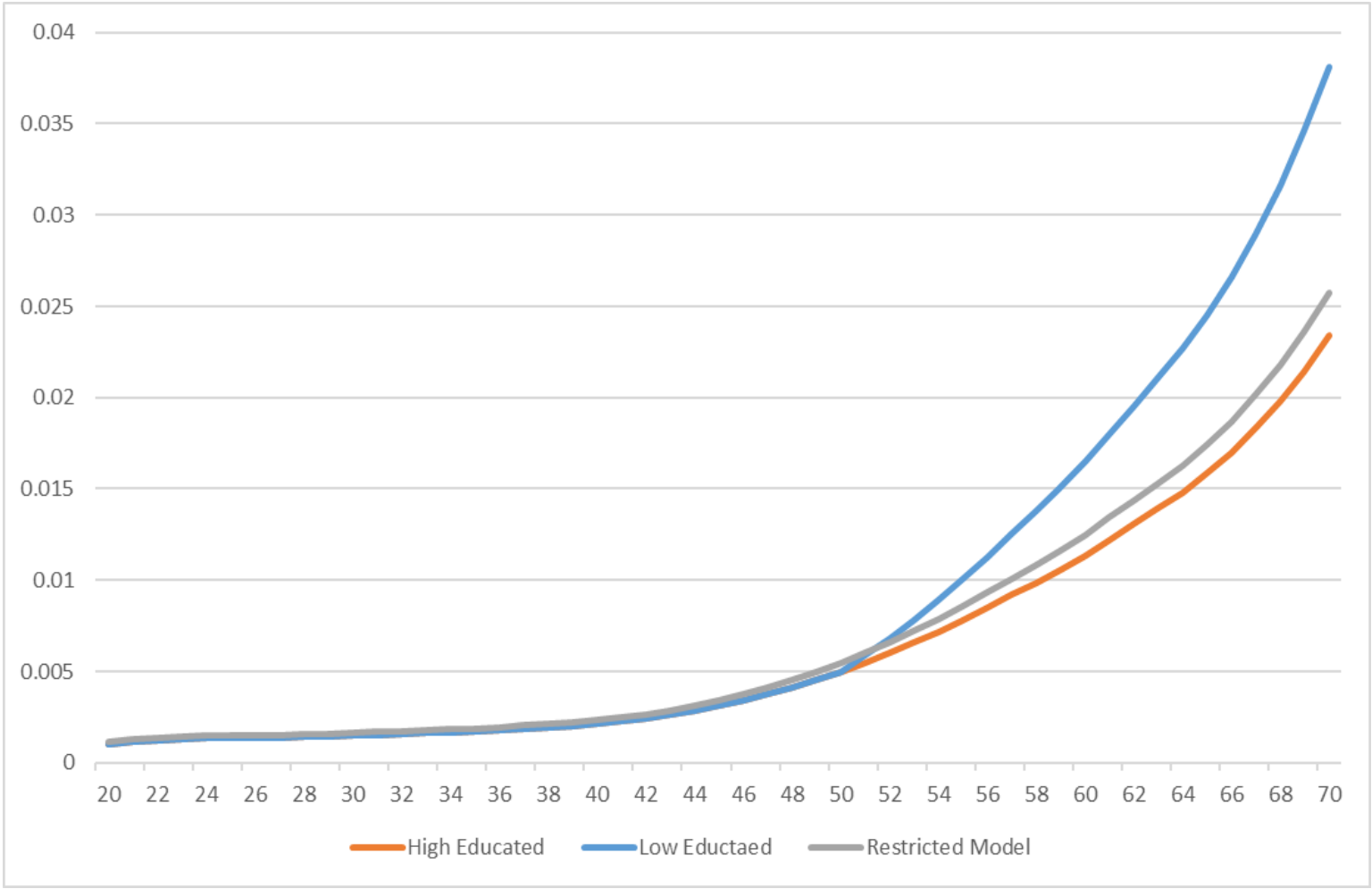
- Behavioral Model Implications

$$\frac{\partial H_{t+1}}{\partial E} - \frac{\partial H_t}{\partial E} = \frac{\partial \alpha_t}{\partial E} I_t - \sum_{k=19}^{t-2} \{[\frac{\partial \alpha_k}{\partial E} I_k \delta_t \prod_{j=k+1}^{t-1} (1-\delta_j)]\} - \delta_t \frac{\partial \alpha_{(t-1)}}{\partial E} I_{t-1}$$

- **If depreciation is zero, then investment is zero and education has no effect on health at that age**
- **If depreciation is constant then health does not change and investment simply offsets depreciation—education has an effect but it does not differ by age (level difference)**

- **Age-profile of health by education is constant in both cases**
- **Identifying the different cases requires measuring investment**

An Empirical Implication of Model—Bias from Restricting the Effect of Education to be same at each age (Meghir et al. 2018)



What do Natural Experiments Estimate?

- Most studies estimate the cumulative effect of education at a given age
- Most studies pool people of very different ages and from different birth cohorts
- Different birth cohorts are affected by changes in the education-ability distribution and this confounds estimates
- Different ages may dampen or obscure effect of education on health because education may have no effect on health at young ages—little scope for education to affect health—and because selective mortality may confound estimates of effect of education on morbidity

Comparison of Clark and Royer (2013) and Davies et al. (2018)

- Both analyze the 1972 educational reform in UK
- Use same methods
- Clark and Royer (2013) examined ages 20-44 and find no effect, although suggestive evidence of a beneficial effect of education reform on mortality for those ages 40-44
- Davies et al. (2018) examined ages 53-62 and find that education reform reduced mortality by 42%

Comparison of Clark and Royer (2013) Age-specific Estimates of 1947 Educational Reform

- Clark and Royer (2013) reported estimates of reform on mortality by age

- We can use following to calculate age-specific effects:

$$\frac{\partial H_{t+1}}{\partial E} - \frac{\partial H_t}{\partial E} = \frac{\partial \alpha_t}{\partial E} I_t - \sum_{k=19}^{t-2} \{[\frac{\partial \alpha_k}{\partial E} I_k \delta_t \prod_{j=k+1}^{t-1} (1-\delta_j)]\} - \delta_t \frac{\partial \alpha_{(t-1)}}{\partial E} I_{t-1}$$

- -0.013 for ages 50-54 (1.3% lower death rate)
- -0.025 for ages 55-59 (2.5% lower death rate)
- 0.005 for ages 60-64
- 0.020 for ages 65-59

The Basic Regression Model of Our Study

$$H_{i(t+1)} - H_{it} = \tilde{\pi}_0 + \pi_{t+1} EDUCATION_i + (e_{i(t+1)} - e_{it})$$

- This is a first-difference (within-person) regression of changes in education on health.
- It measures the effect of education on health at that age—education may affect the amount of investment and the effect of the investment
- The estimate of interest can be obtained by simply taking differences in health between ages for low- and high-educated persons and then subtracting

The Basic Regression Model of Our Study

$$H_{i(t+1)} - H_{it} = \tilde{\pi}_0 + \pi_{t+1} EDUCATION_i + (e_{i(t+1)} - e_{it})$$

- Confounding? We ignore the issue in this study, but instrumental variables approaches, such as use of compulsory schooling laws, can be applied to this model

- The fixed effect approach may eliminate, at least partially, the effect of some time-invariant factors (as long as they do not moderate effect of investment)

Chicago Heart Association (CHA) Detection Project in Industry

- The CHA assessed cardiovascular health risk factors (e.g., blood pressure and serum cholesterol) and collected demographic information for approximately 40,000 Chicago employees between 1967 and 1973

- We focused on CHA participants who were 30 to 40 years old at baseline (at the time of the CHA study) and were alive at age 40.

- Two cohorts: 1927-34 and 1935-42

- Linked to death records

Table 1. Summary Statistics for CHA Cohorts at Baseline

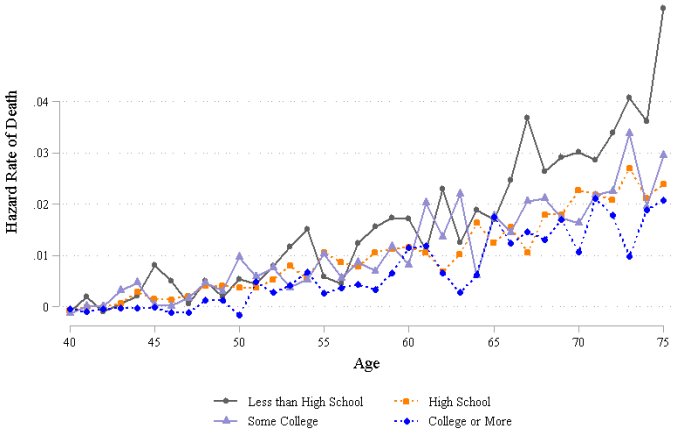
1927-1934 Birth Cohort	Less than High School	High School	Some College	College or More
Age (year)	37.88	37.85	37.85	37.62
Female	0.35	0.47	0.31	0.13
White	0.75	0.89	0.85	0.93
Black	0.16	0.09	0.12	0.04
Height (inch)	66.65	67.14	68.27	69.59
Baseline Health Status (fraction with):				
Favorable Health (all factors were favorable)	0.02	0.06	0.06	0.06
1+ Health Factors were Elevated but None High	0.13	0.17	0.20	0.26
One Health Factor was High	0.41	0.41	0.43	0.42
2+ Health Factors were High	0.44	0.36	0.31	0.26
Number of Unique Persons (Total = 4,097)	679	1,513	675	1,230
Number of Person-years (Total =133,856)	21,282	49,727	21,685	41,162

1935-1942 Birth Cohort	Less than High School	High School	Some College	College or More
Age (year)	32.72	32.56	32.51	32.30
Female	0.39	0.40	0.29	0.16
White	0.60	0.82	0.76	0.92
Black	0.25	0.16	0.20	0.04
Height (inch)	66.80	67.56	68.21	69.53
Baseline Health Status (fraction with):				
Favorable Health (all factors were favorable)	0.06	0.06	0.09	0.09
1+ Health Factors were Elevated but None High	0.14	0.18	0.20	0.28
One Health Factor was High	0.40	0.43	0.42	0.41
2+ Health Factors were High	0.39	0.31	0.28	0.22
Number of Unique Persons (Total = 4,814)	665	1,594	960	1,595
Number of Person-years (Total =140,667)	18,950	46,230	28,095	47,392

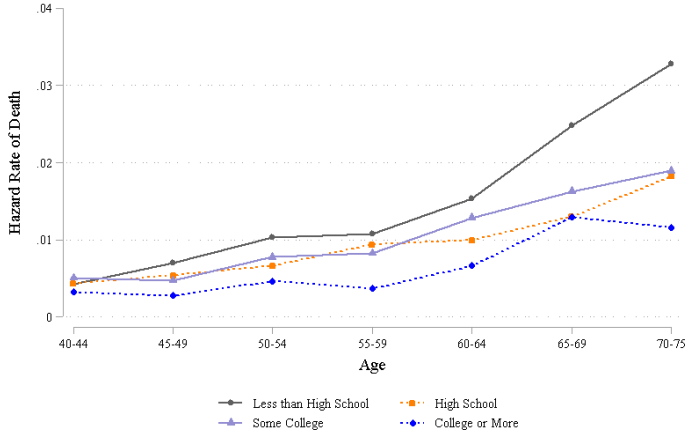
Predicted Hazard Rate of Death by Education and Age

Figure 2. Predicted Hazard Rate of Death by Education and Age – CHA Cohorts

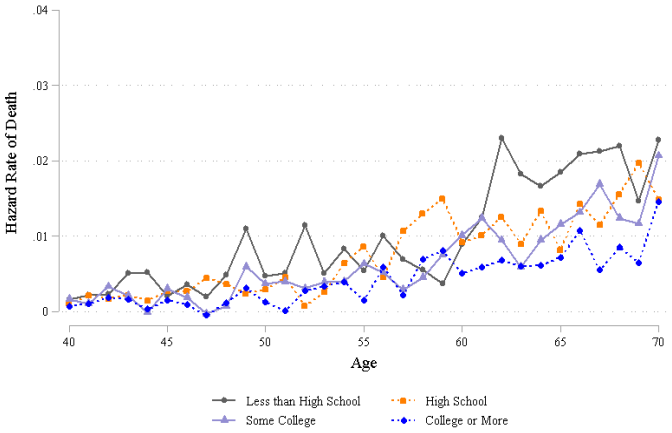
1927-1934 Birth Cohort



1927-1934 Birth Cohort



1935-1942 Birth Cohort



1935-1942 Birth Cohort

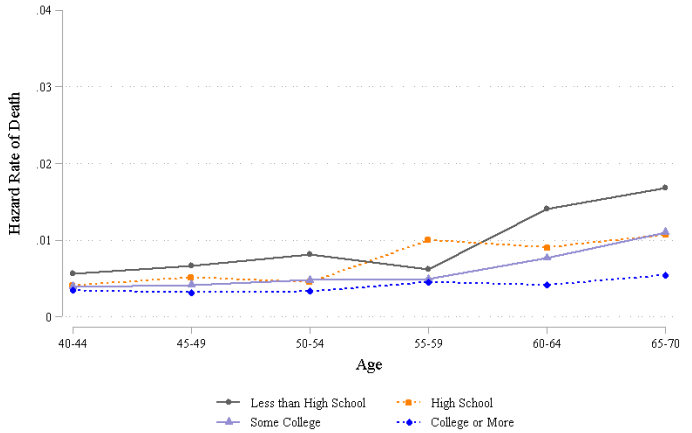
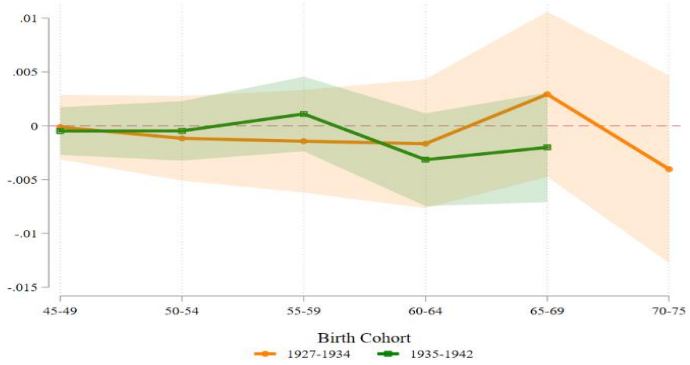
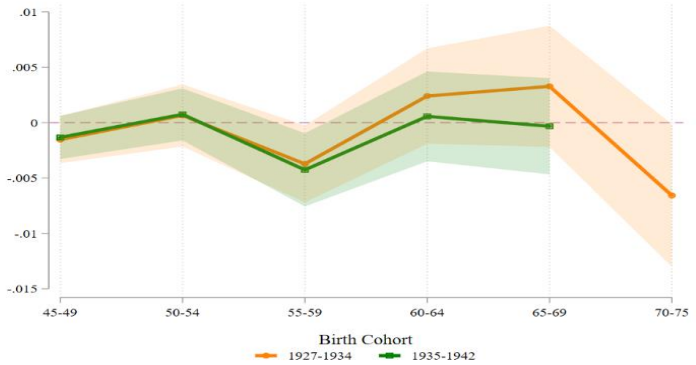


Figure 3. Difference-in-Differences in the Hazard Rate of Death by Education and Age - CHA Cohorts

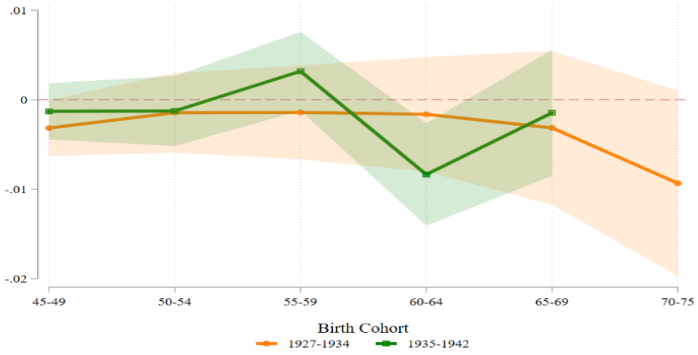
a. BA Degree or Greater – Some College



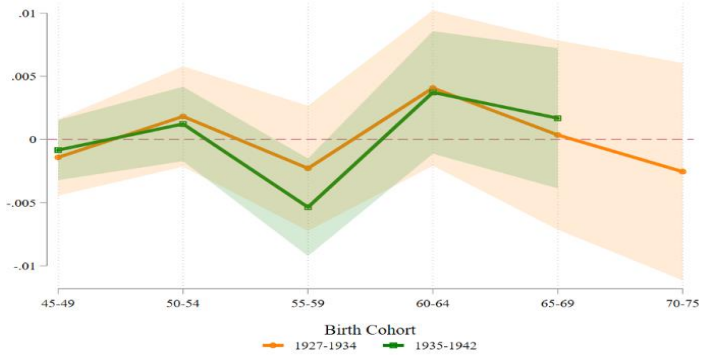
b. BA Degree or Greater – HS Degree



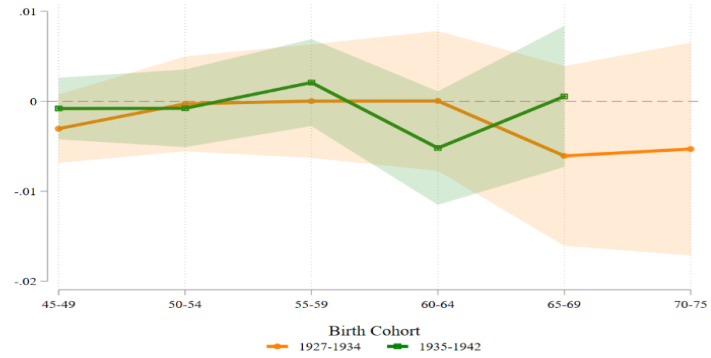
c. BA Degree or Greater – Less than HS Degree



d. Some College – HS Degree



e. Some College – Less than HS Degree



f. HS Degree – Less than HS Degree

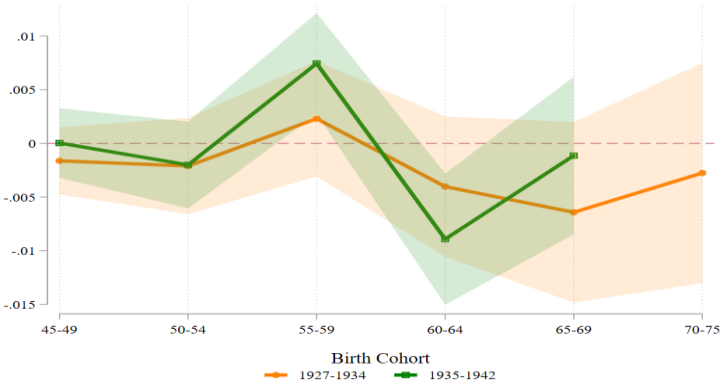


Table 4. Differences in the Predicted Probability of Survival by Education - CHA Cohorts

1927-1934 Birth Cohort	Live to Age 50	Live to Age 60	Live to Age 70	Live to Age 75
BA - SC	0.030	0.050	0.090	0.109
BA - HS	0.024	0.053	0.070	0.083
BA - LTHS	0.032	0.086	0.164	0.217
SC - HS	-0.006	0.002	-0.020	-0.026
SC - LTHS	0.002	0.036	0.074	0.107
HS - LTHS	0.008	0.034	0.094	0.134
Mean Survival Rate for LTHS	0.972	0.868	0.687	0.562
1935-1942 Birth Cohort	**Live to Age 50**	**Live to Age 60**	**Live to Age 70**	
BA - SC	0.010	0.021	0.058	
BA - HS	0.014	0.047	0.085	
BA - LTHS	0.031	0.058	0.143	
SC - HS	0.004	0.026	0.027	
SC - LTHS	0.021	0.037	0.085	
HS - LTHS	0.017	0.011	0.057	
Mean Survival Rate for LTHS	0.957	0.891	0.735	

Summary
Chicago Heart Association (CHA) Detection Project in Industry

- Evidence that education matters, but mainly at after age 55
- Results imply that studies that pool ages may be missing real effects
- Results point to the mechanisms through which education affects health. Why at age 55?
- Not much of a difference by cohort—no systematic evidence that effect is changing in one or another direction

NHIS 1945-49 Birth Cohort

- The NHIS 1986-1989 surveys
- Respondents 40 years old at baseline and followed until time of death or 2009
- Linked to death records

Predicted Hazard Rate of Death by Education and Age

Figure 4: Predicted Hazard Rate of Death by Education and Age Among Non-Hispanic, White NHIS Respondents (1945-1949 Birth Cohort)

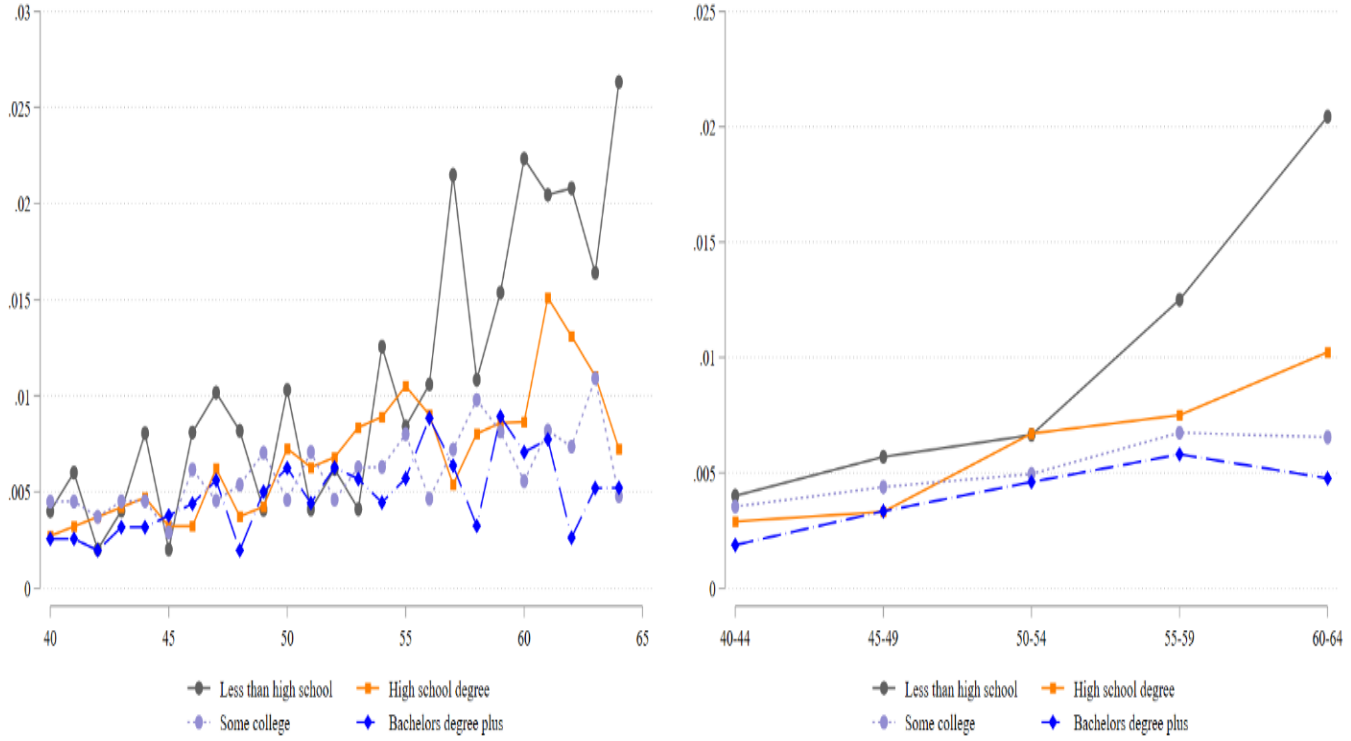
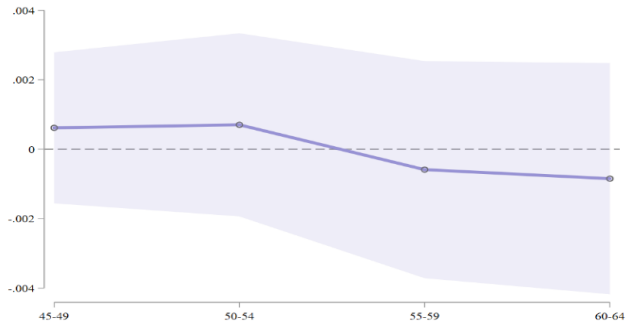
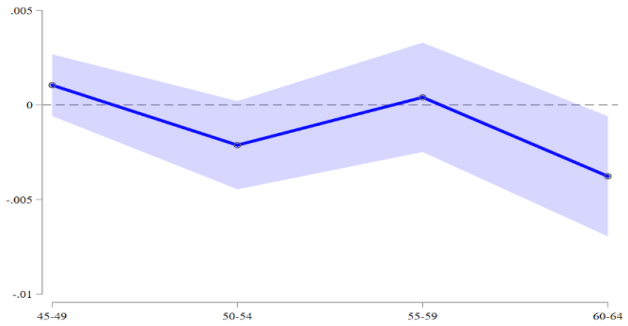


Figure 5: Difference-in-Differences in the Hazard Rate of Death by Education and Age Among Non-Hispanic, White NHIS Respondents (1945-1949 Birth Cohort)

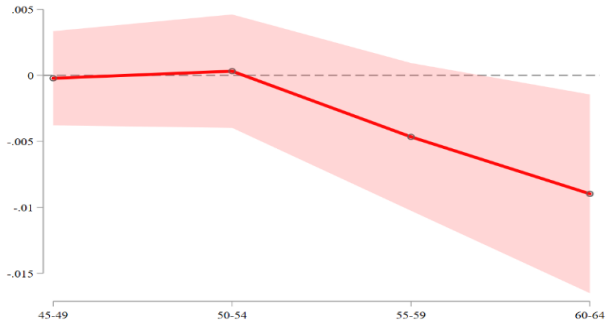
a. BA Degree or Greater – Some College



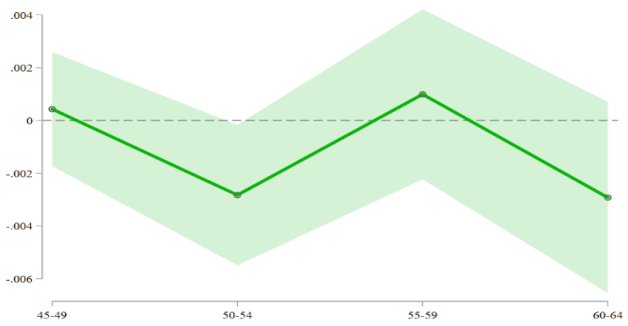
b. BA Degree or Greater – HS Degree



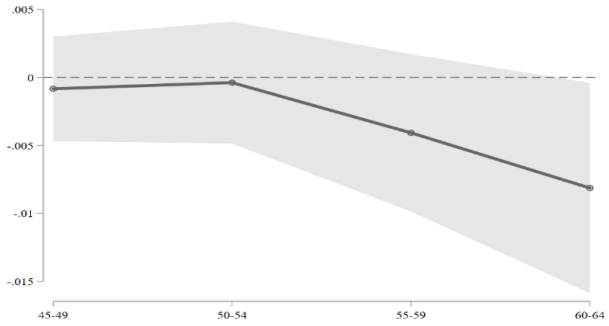
c. BA Degree or Greater – Less than HS Degree



d. Some College – HS Degree



e. Some College – Less than HS Degree



f. HS Degree – Less than HS Degree

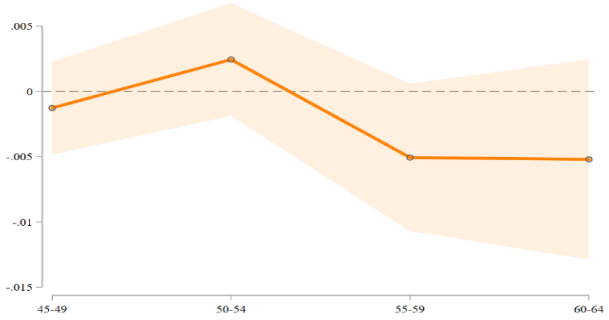


Table 5. Differences in Predicted Probability of Survival by Education
NHIS Non-Hispanic Whites 1945-1949 Birth Cohort

1945-1949 Birth Cohort	Live to Age 50	Live to Age 60	Live to Age 64
BA – SC	0.010	0.015	0.024
BA – HS	0.003	0.019	0.041
BA – LTHS	0.025	0.074	0.125
SC – HS	-0.007	0.004	0.017
SC – LTHS	0.015	0.059	0.102
HS – LTHS	0.022	0.055	0.085
Mean Survival Rate for LTHS	0.956	0.868	0.804

Summary
NHIS 1945-49 Cohort

- Evidence that education matters, but mainly at after age 55
- Results point to the mechanisms through which education affects health. Why at age 55?
- Not much of a difference by cohort—no systematic evidence that effect is changing in one or another direction

National Health Interview Survey 1976 to 2016

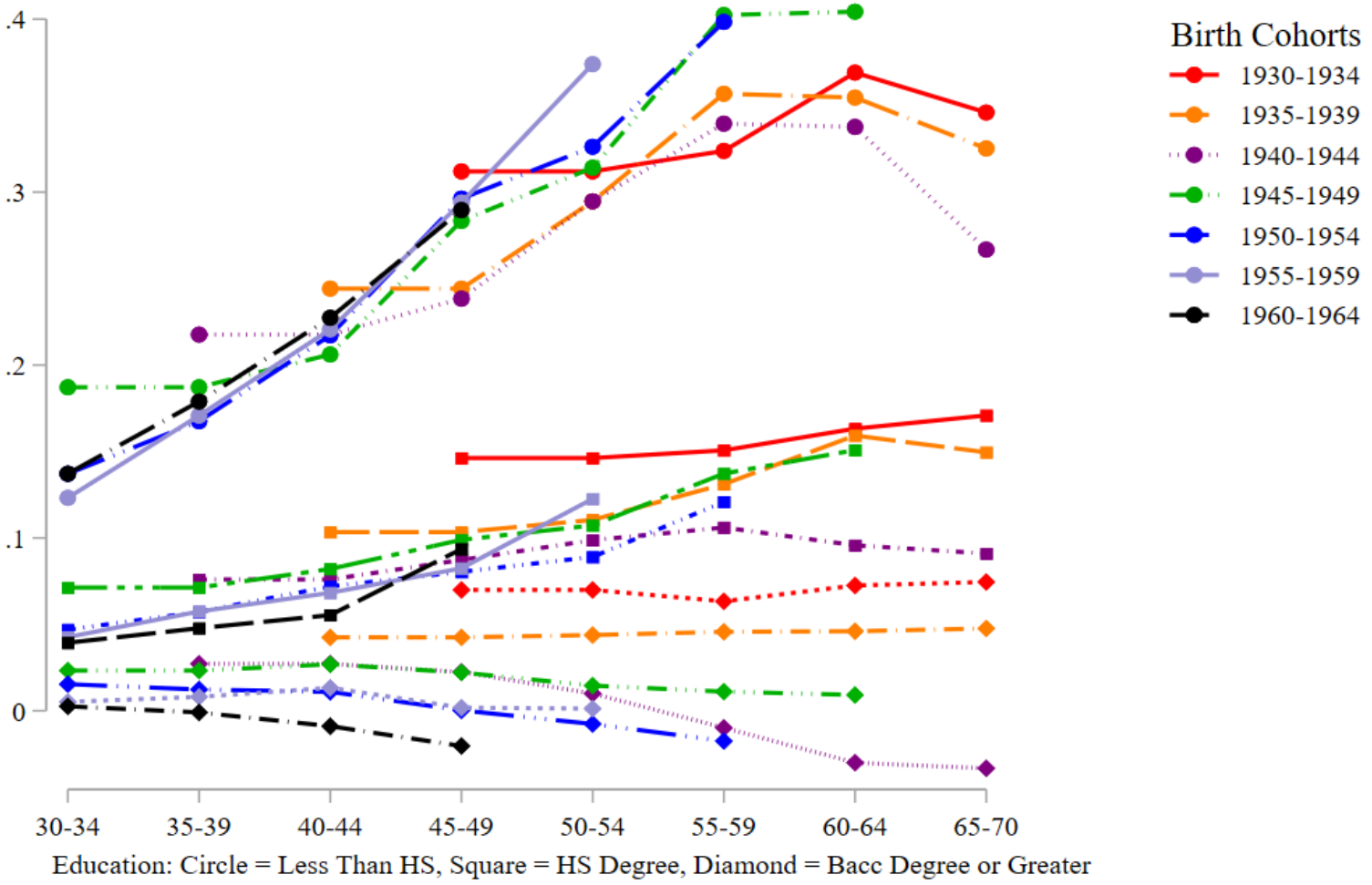
- Series of cross-sectional surveys
- Divide into 5-year birth cohorts: 1930-34, 1935-39, 1940-44, 1945-49, 1950-54, 1955-59, 1960-64

- Limit to white, non-Hispanic: NHIS is representative of cross-section and not cohort; so selection on race minimizes compositional change among cohorts by race/ethnicity

- Analyses done by (synthetic) cohort—equivalent of a within-person analysis assuming sampling picks a random (i.e., same) person each year

- Self-reported outcomes: self-rated health, activity limitations, hospitalization, hypertension, diabetes and widowed

National Health Interview Survey 1982 to 2016
Proportion in Poor Health



National Health Interview Survey 1982 to 2016
Proportion in Poor Health

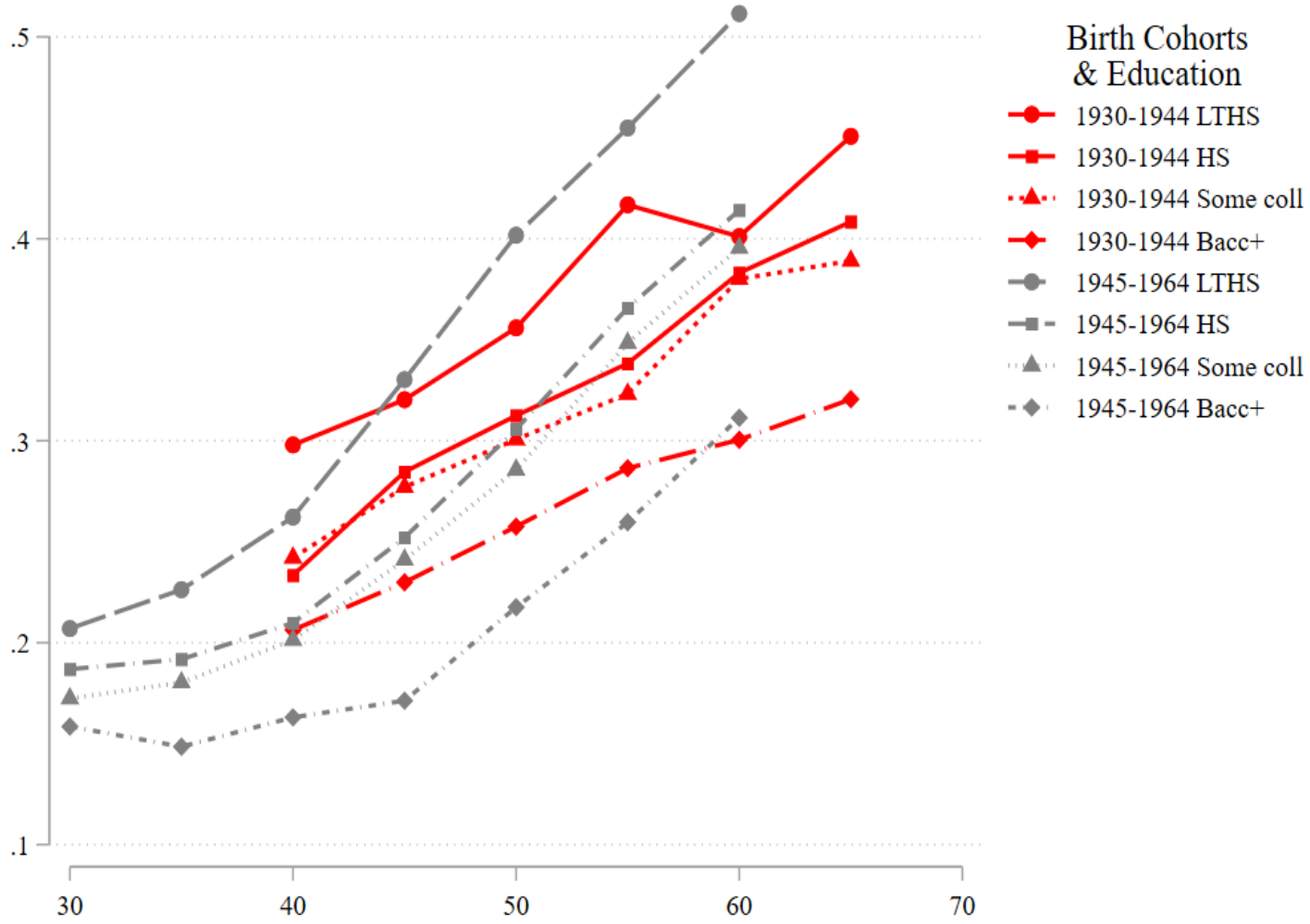
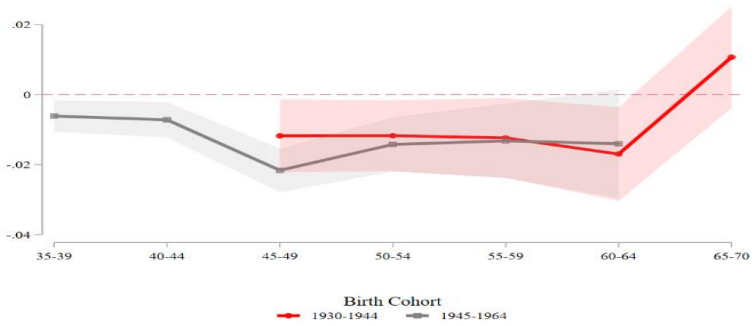
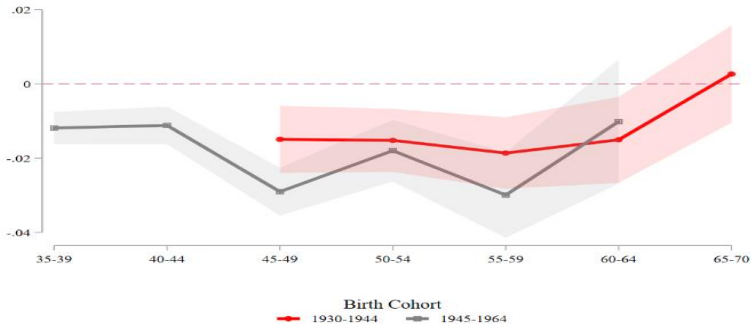


Figure 2: Differences-in-Differences Estimates of the Effect of Education on the Probability of Reporting Poor Health by Age for Non-Hispanic, White NHIS Respondents

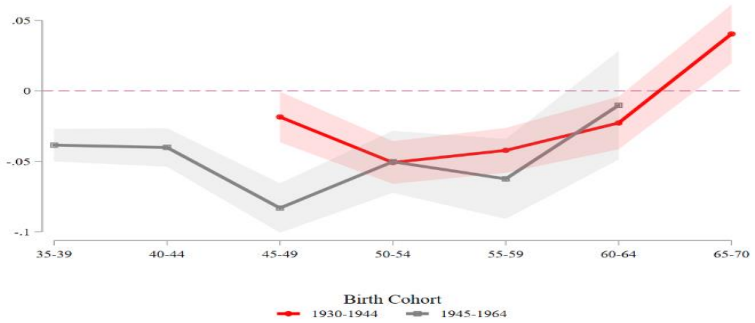
a: BA Degree or Greater – Some College



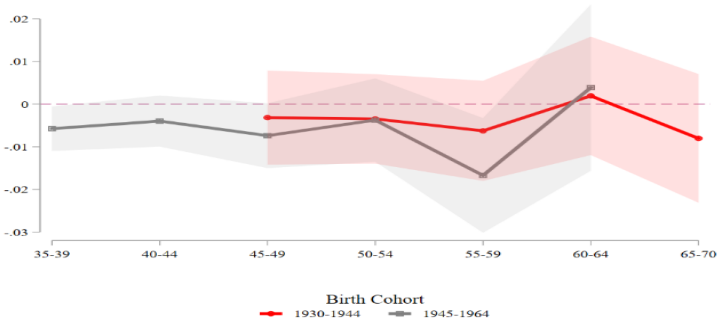
b: BA Degree or Greater – HS Degree



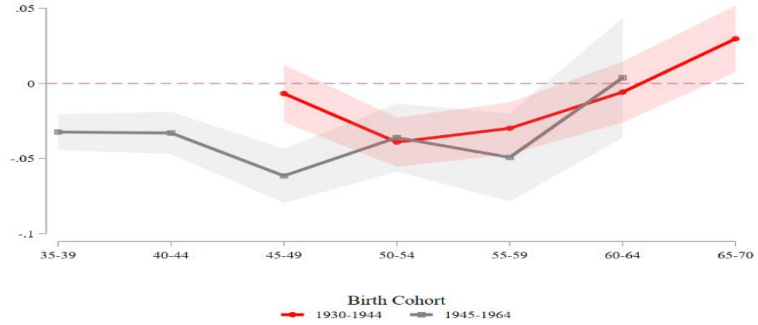
c: BA Degree or Greater – Less Than HS Degree



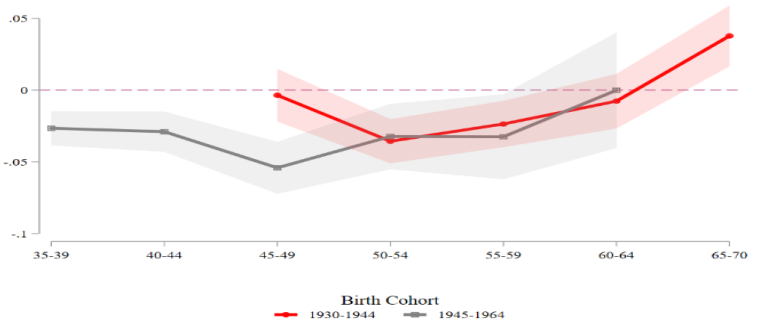
d: Some College –HS Degree



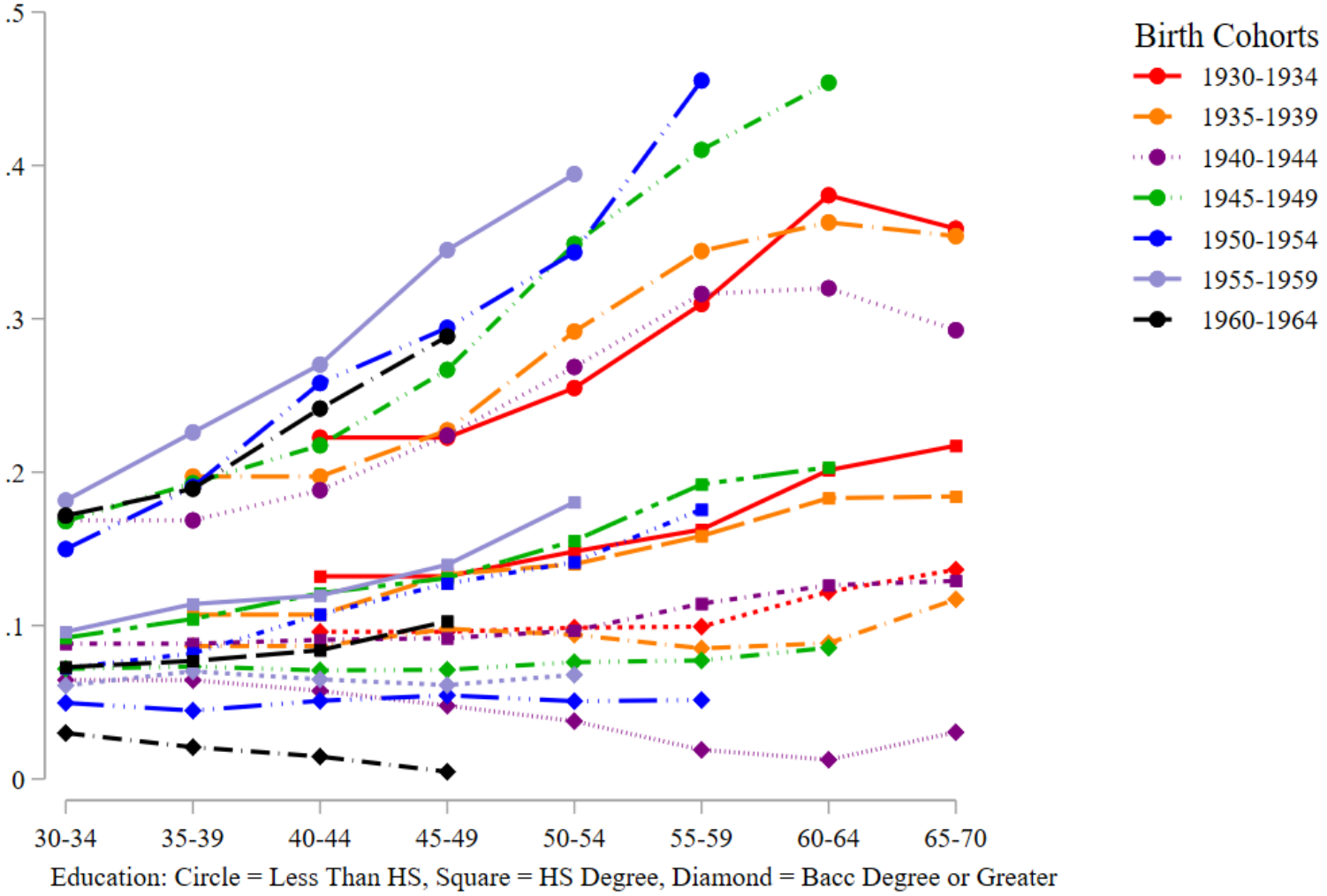
e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree



National Health Interview Survey 1976 to 2016
Proportion with Any Limitation



National Health Interview Survey 1976 to 2016
Proportion with Any Limitation

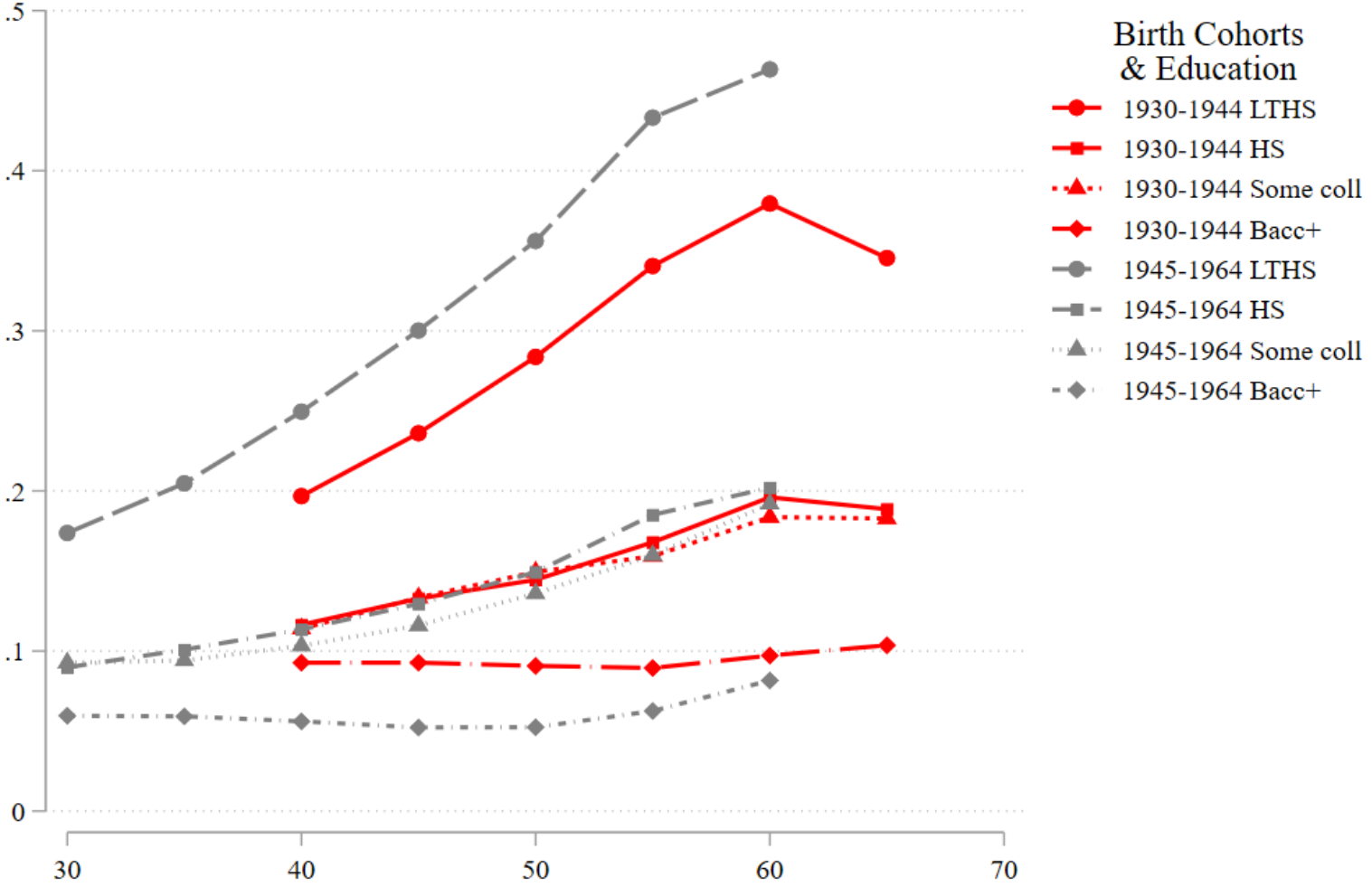
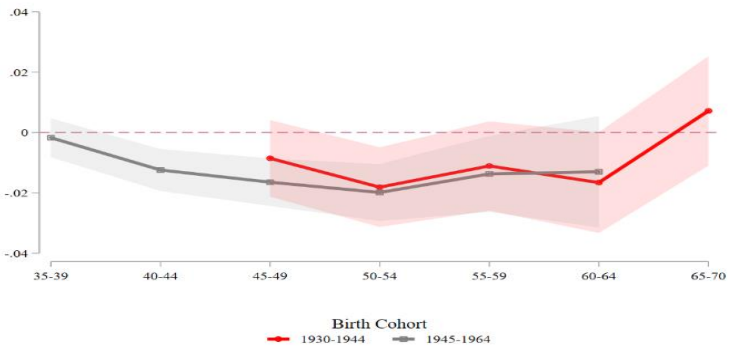
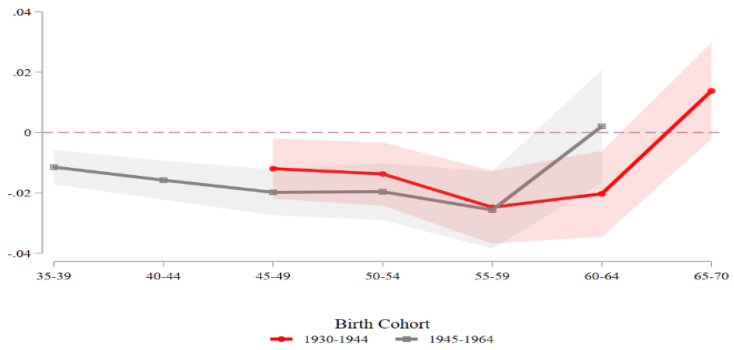


Figure 4: Differences-in-Differences Estimates of the Effect of Education on the Probability of Reporting Any Limitation by Age for Non-Hispanic, White NHIS Respondents

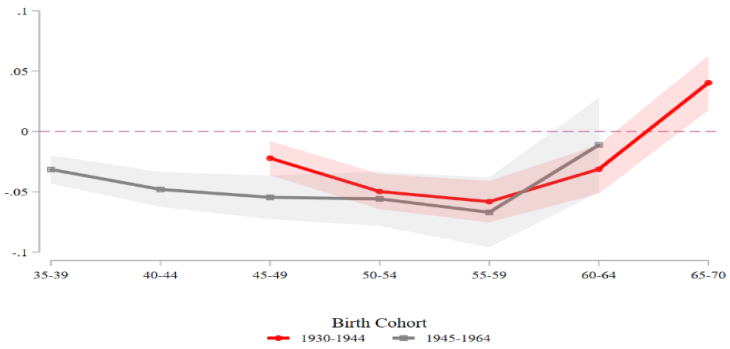
a: BA Degree or Greater – Some College



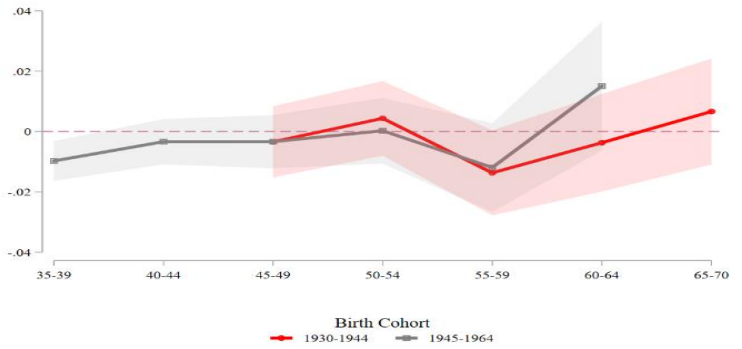
b: BA Degree or Greater – HS Degree



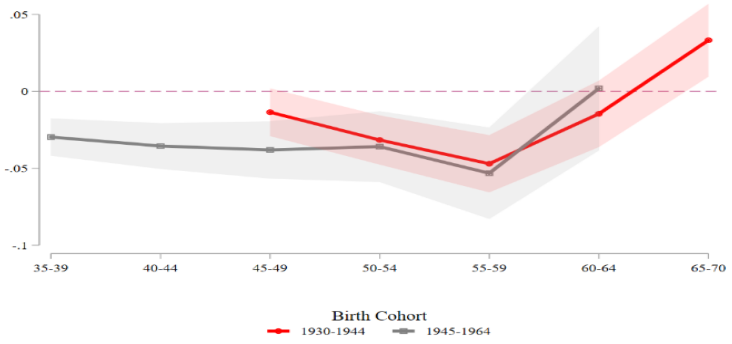
c: BA Degree or Greater – Less Than HS Degree



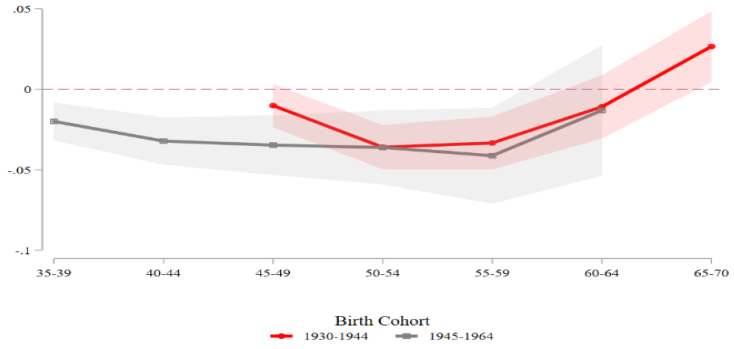
d: Some College – HS Degree



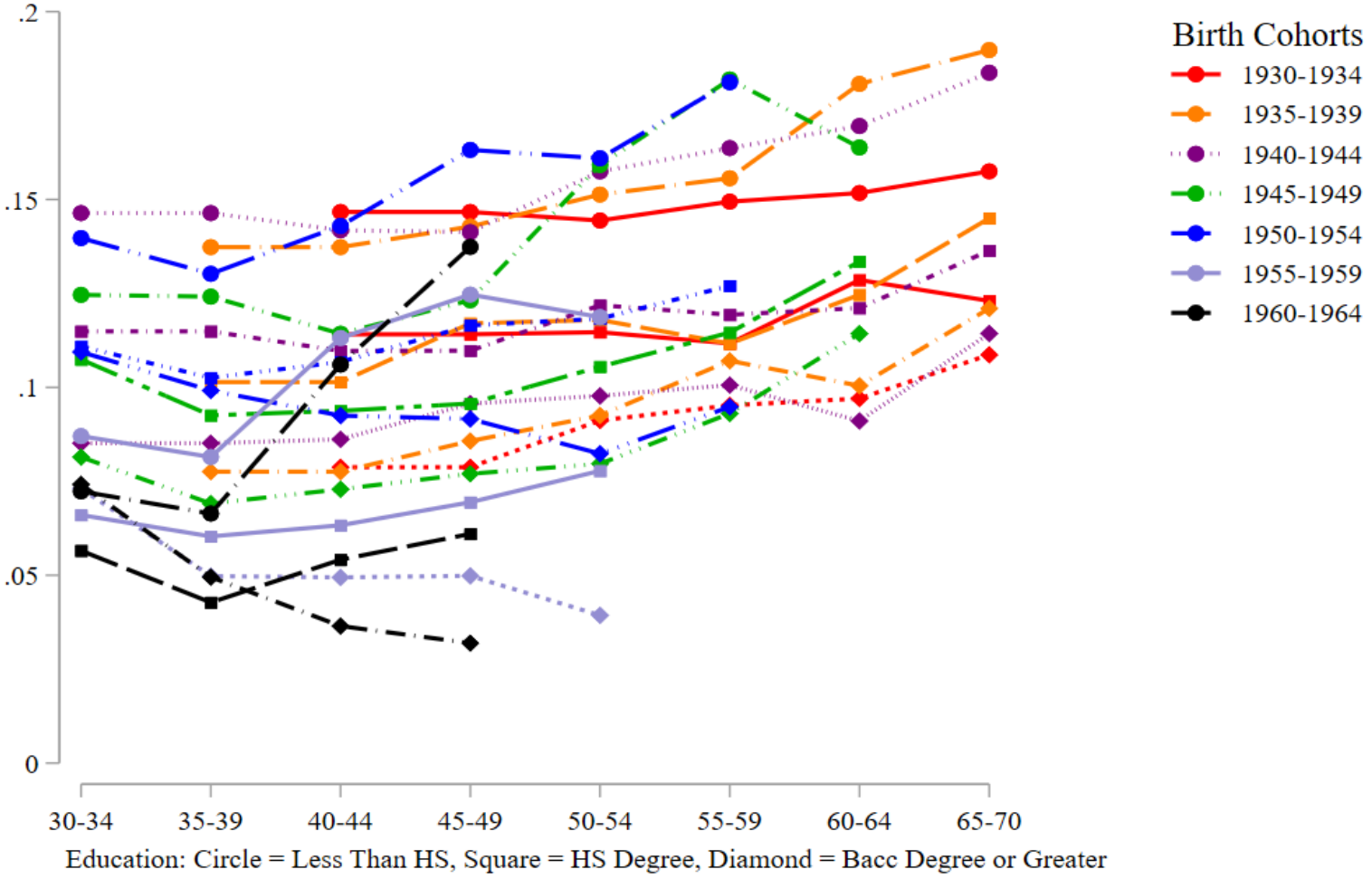
e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree



National Health Interview Survey 1976 to 2016
Proportion with Hospitalization



National Health Interview Survey 1976 to 2016
Proportion with Hospitalization

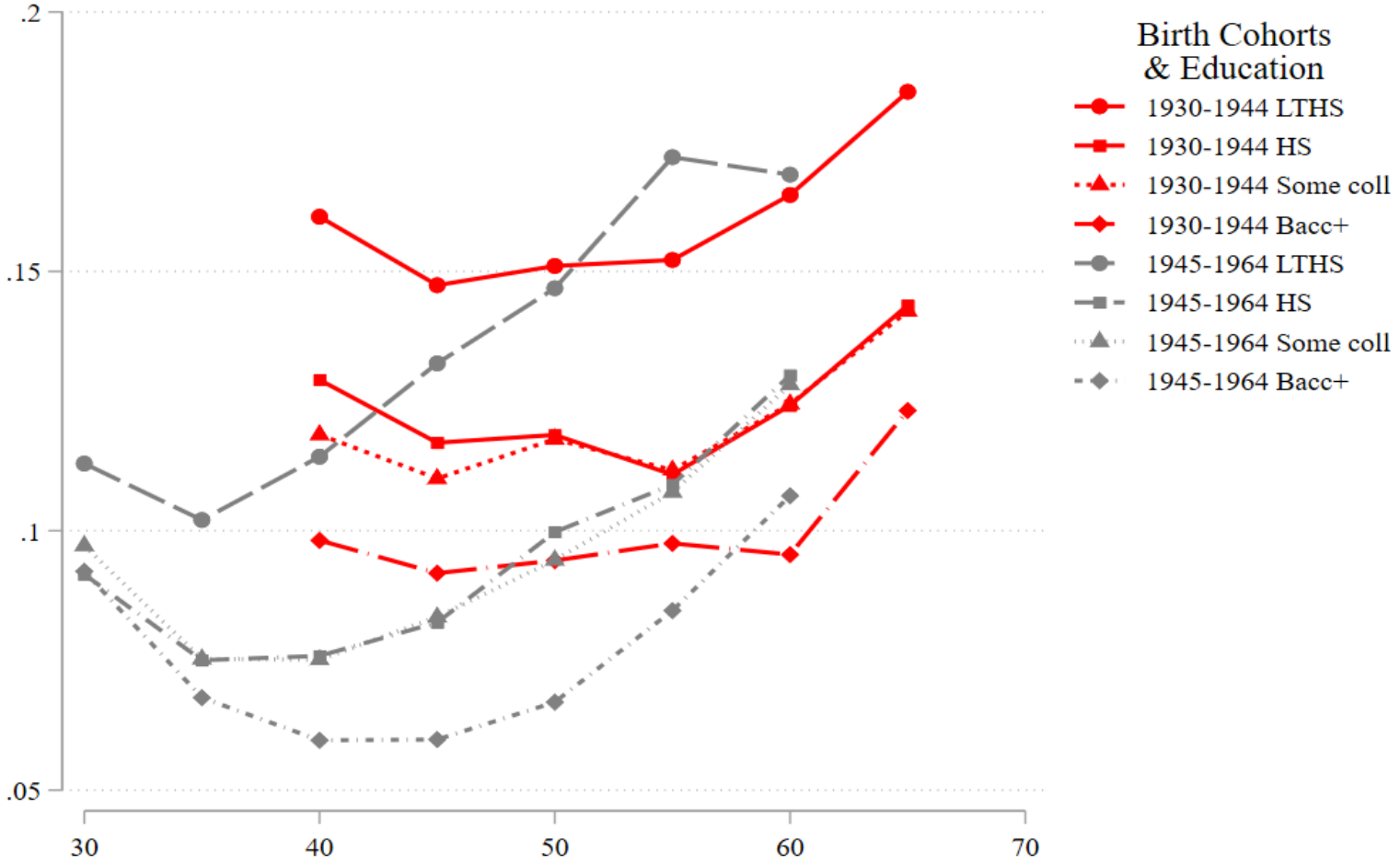
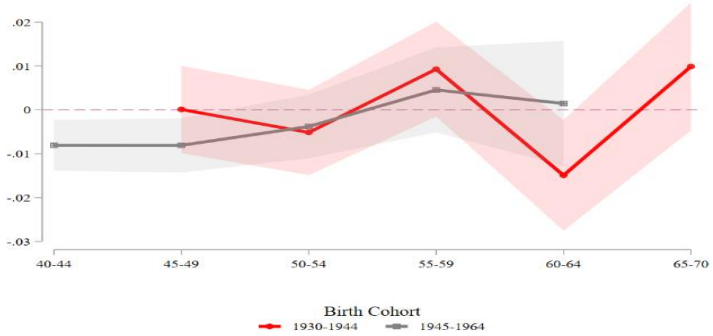
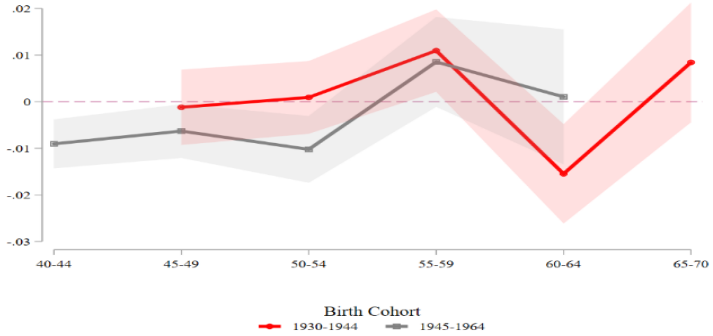


Figure 6: Differences-in-Differences Estimates of the Effect of Education on the Probability of Reporting 1+ Night of Hospitalization in Last 12 Months by Age for Non-Hispanic, White NHIS Respondents

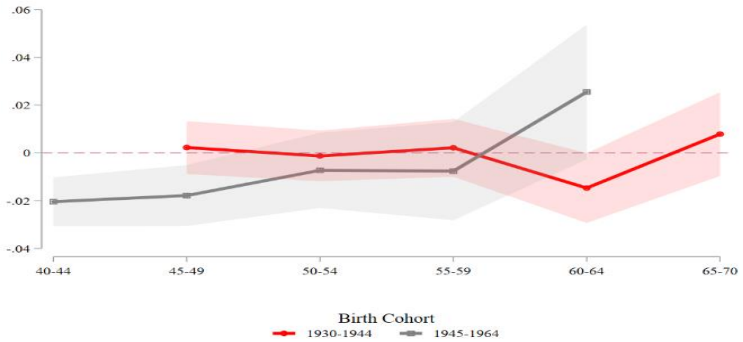
a: BA Degree or Greater – Some College



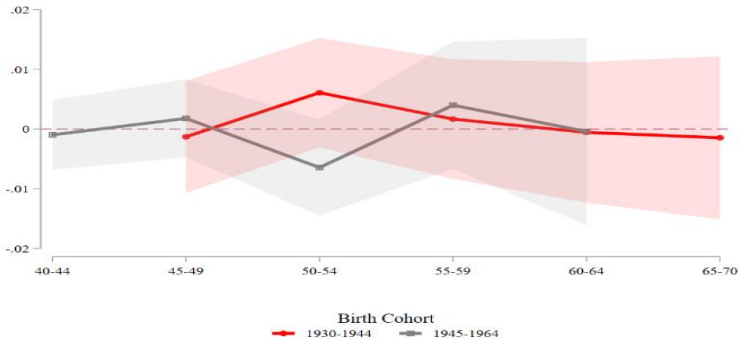
b: BA Degree or Greater – HS Degree



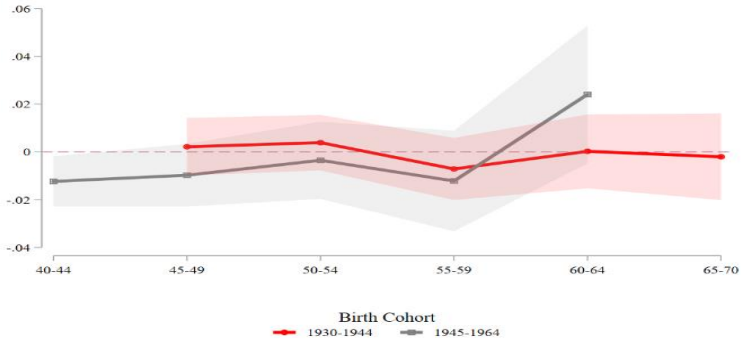
c: BA Degree or Greater – Less Than HS Degree



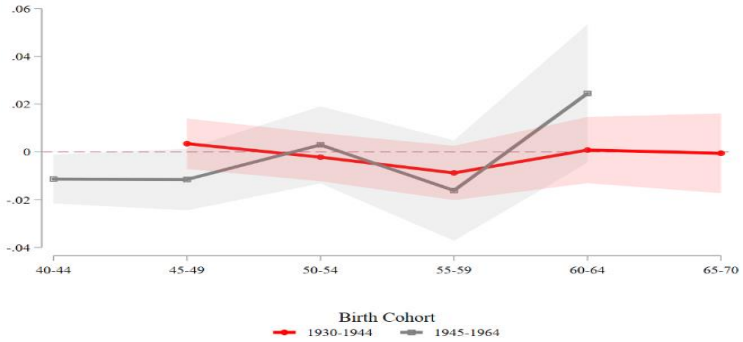
d: Some College – HS Degree



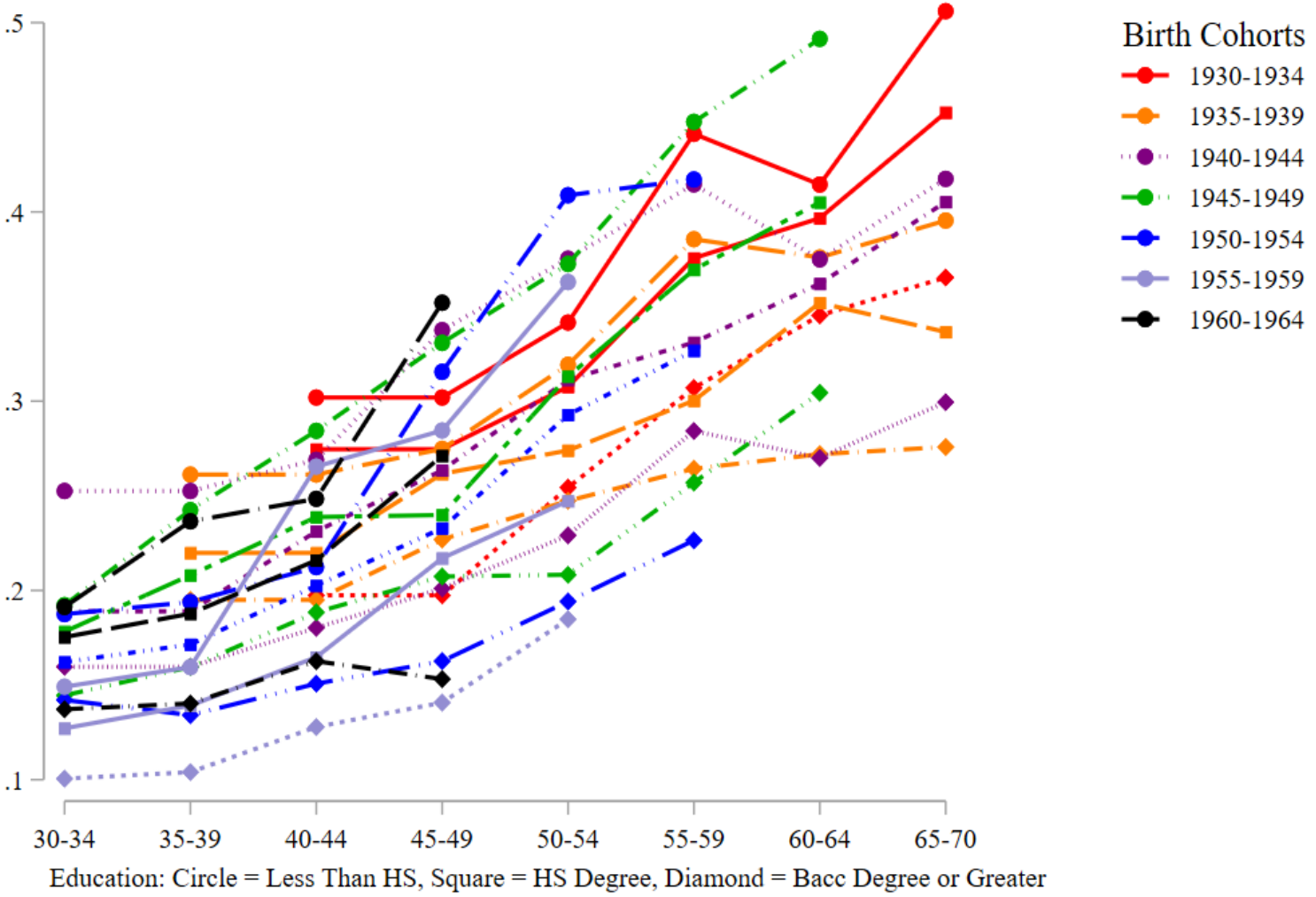
e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree



National Health Interview Survey 1976 to 2016
Proportion with Hypertension



National Health Interview Survey 1976 to 2016
Proportion with Hypertension

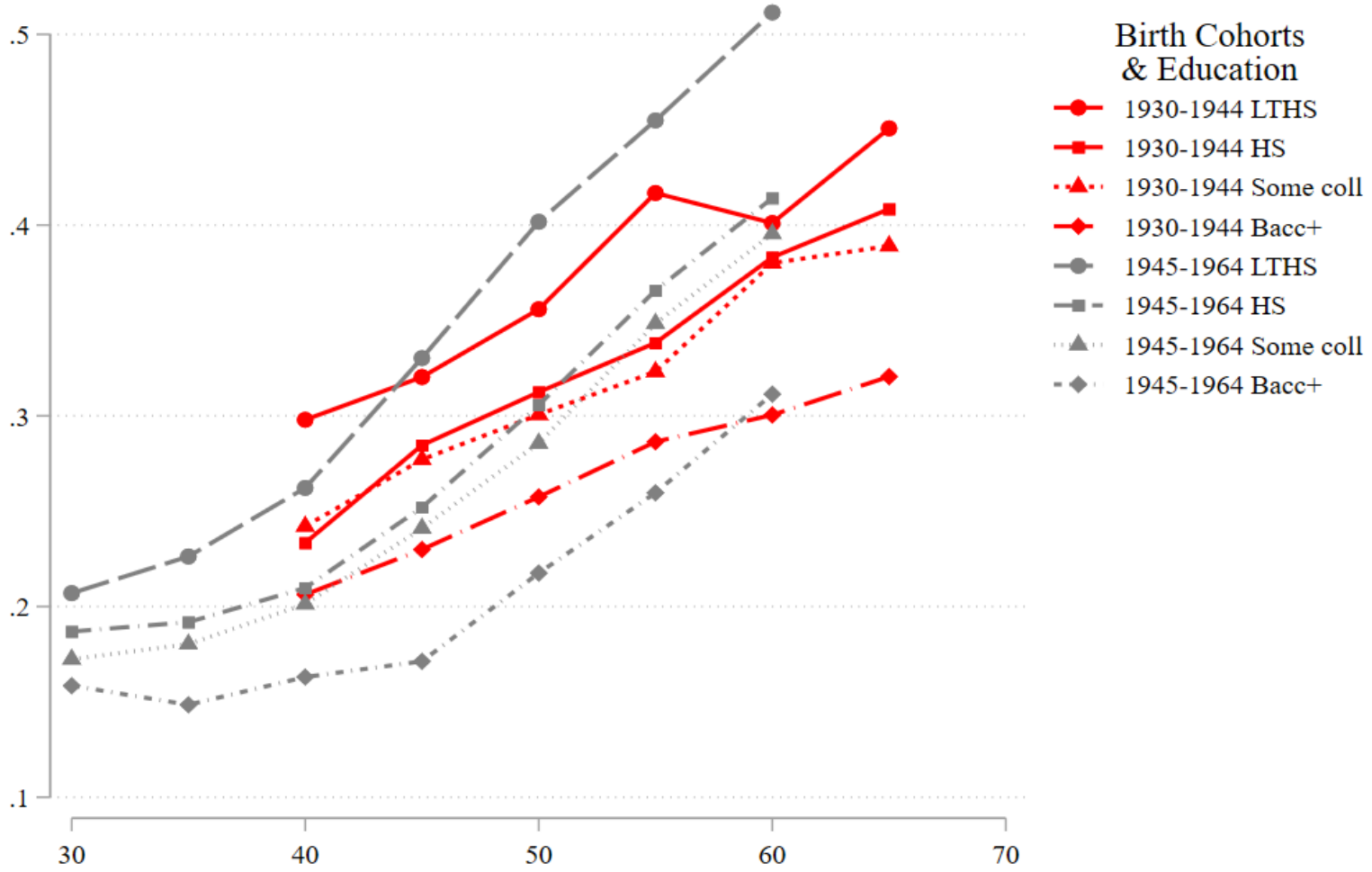
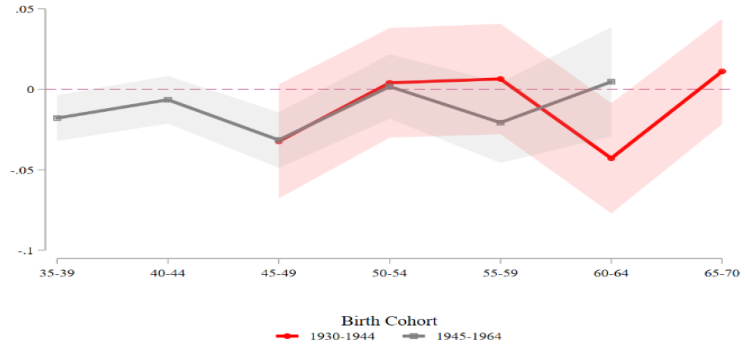
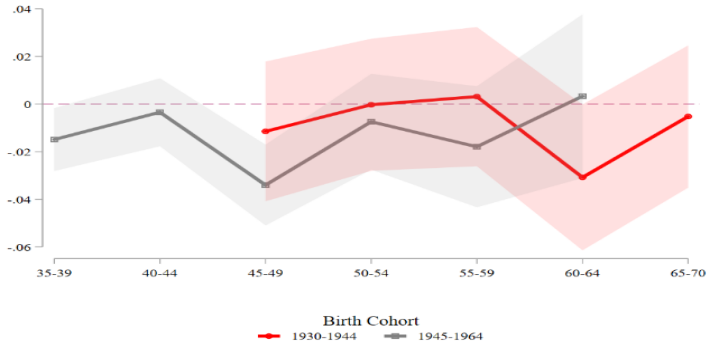


Figure 8: Differences-in-Differences Estimates of the Effect of Education on the Probability of Being Diagnosed with Hypertension by Age for Non-Hispanic, White NHIS Respondents

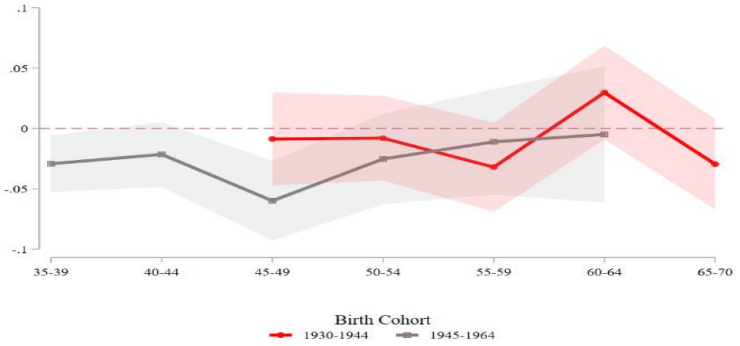
a: BA Degree or Greater – Some College



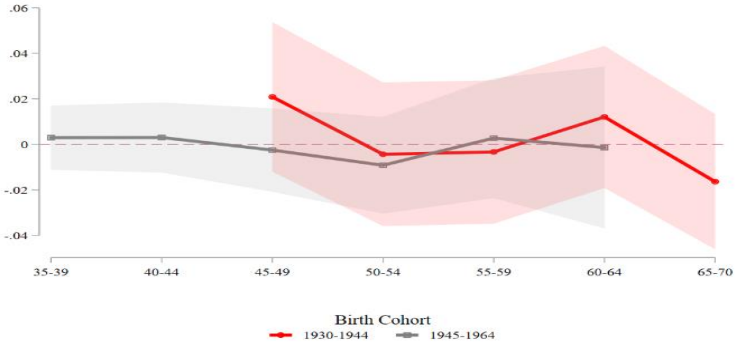
b: BA Degree or Greater – HS Degree



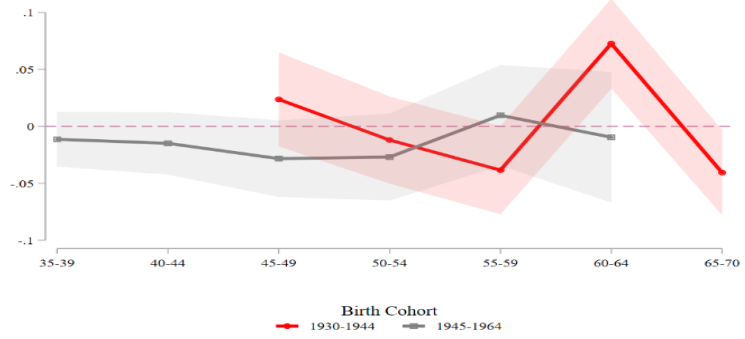
c: BA Degree or Greater – Less Than HS Degree



d: Some College – HS Degree

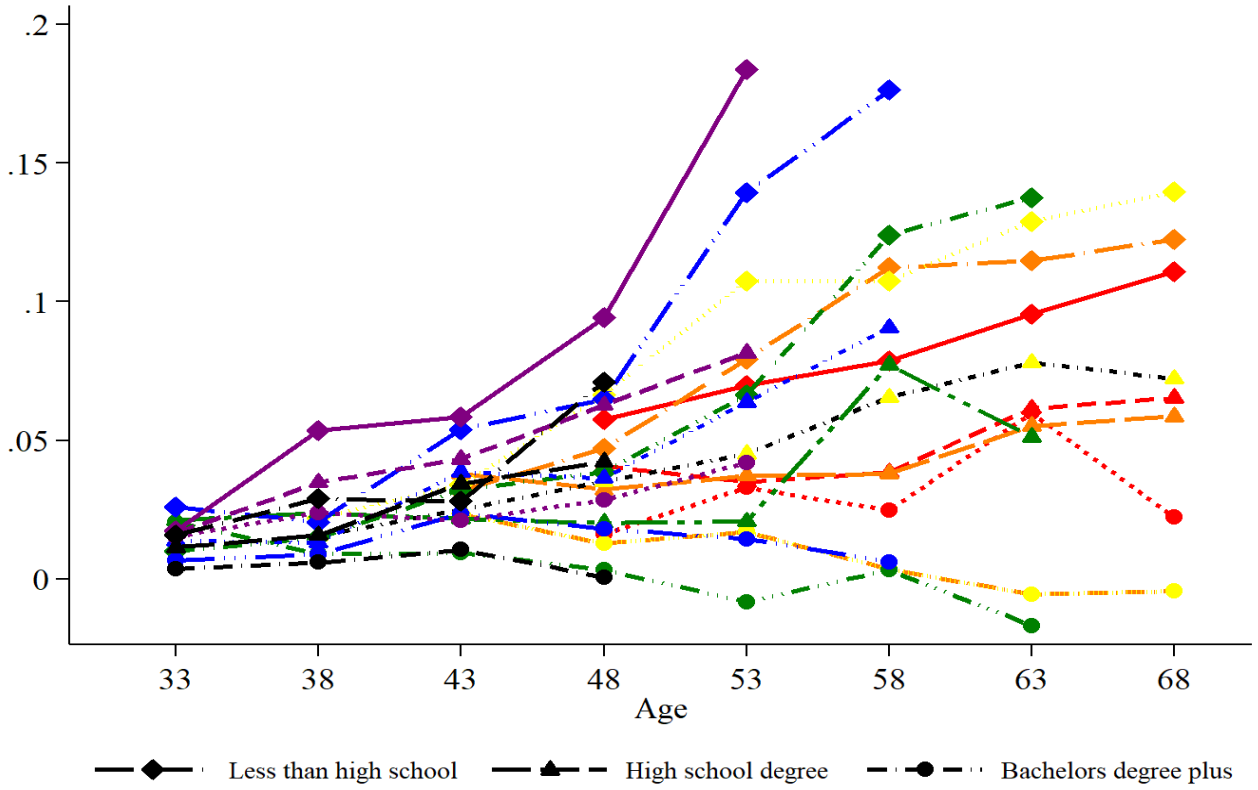


e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree

National Health Interview Survey 1976 to 2016
Proportion with Diabetes



National Health Interview Survey 1976 to 2016
Proportion with Diabetes

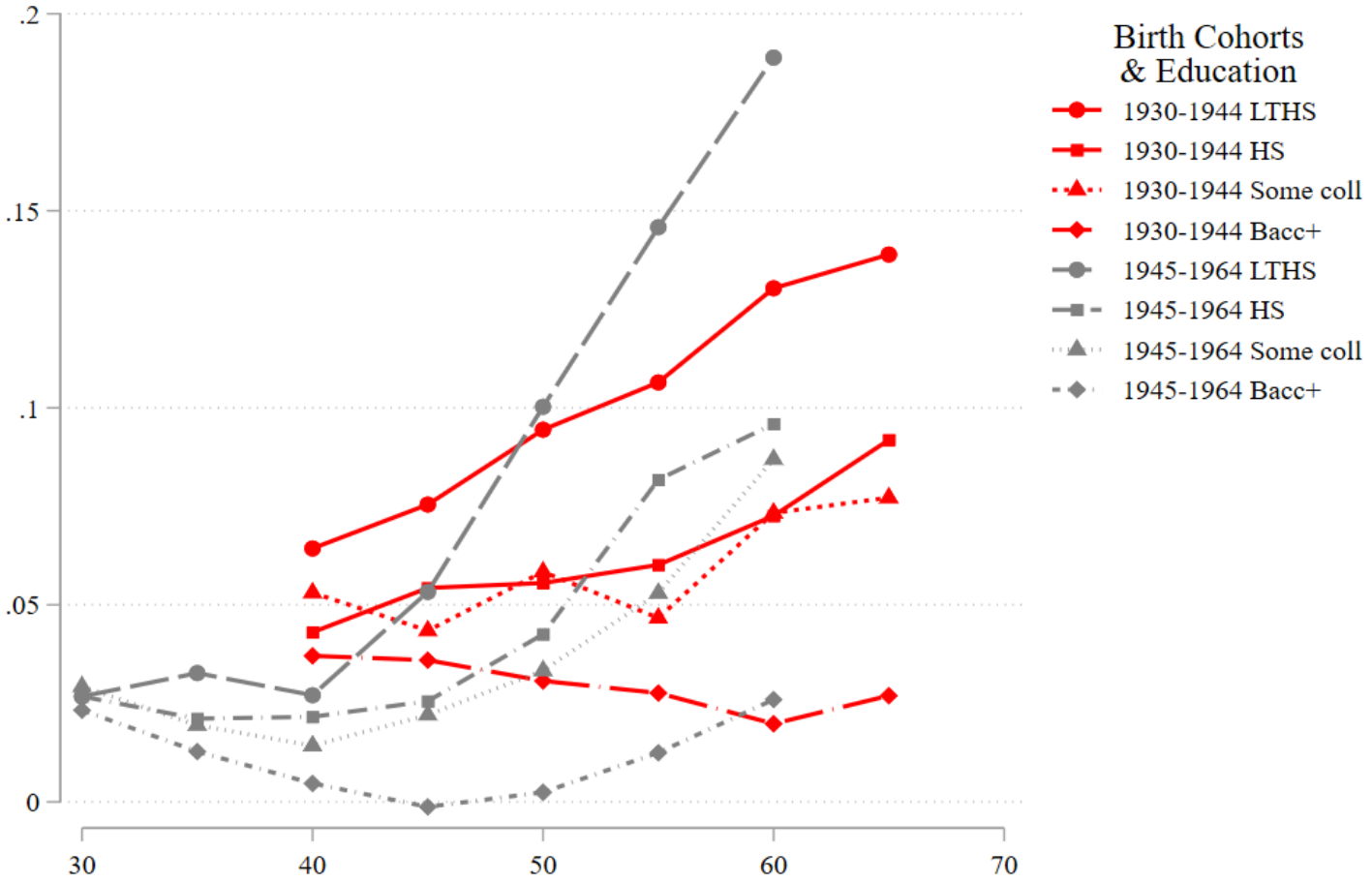
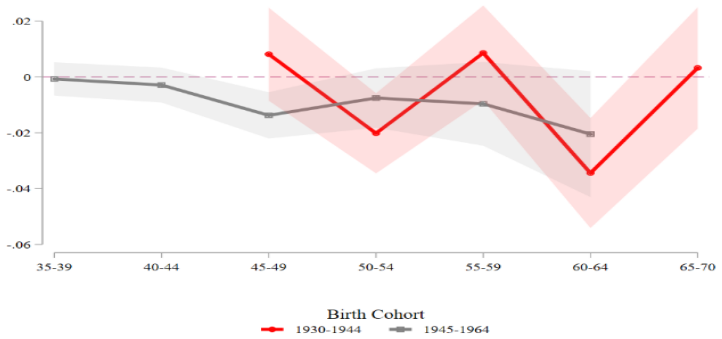
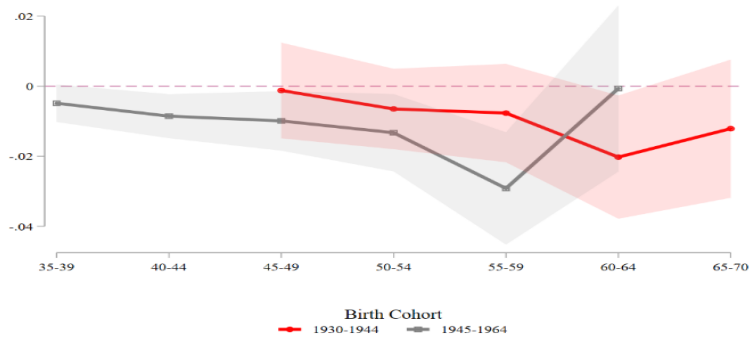


Figure 10: Differences-in-Differences Estimates of the Effect of Education on the Probability of Being Diagnosed with Diabetes by Age for Non-Hispanic, White NHIS Respondents

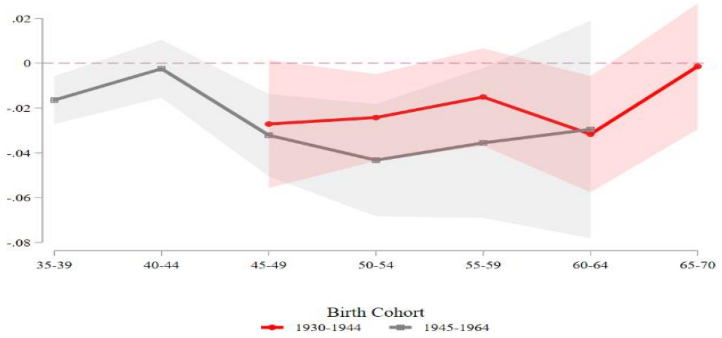
a: BA Degree or Greater – Some College



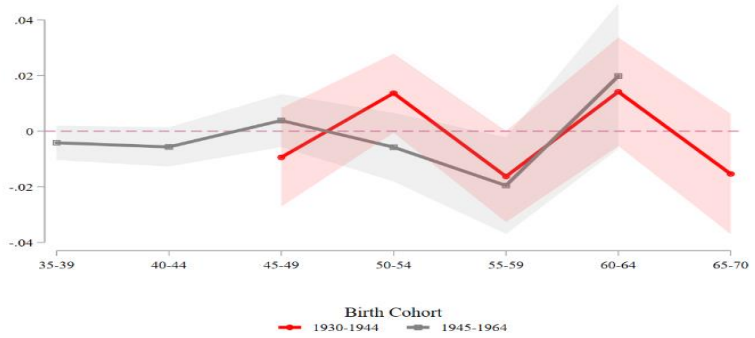
b: BA Degree or Greater – HS Degree



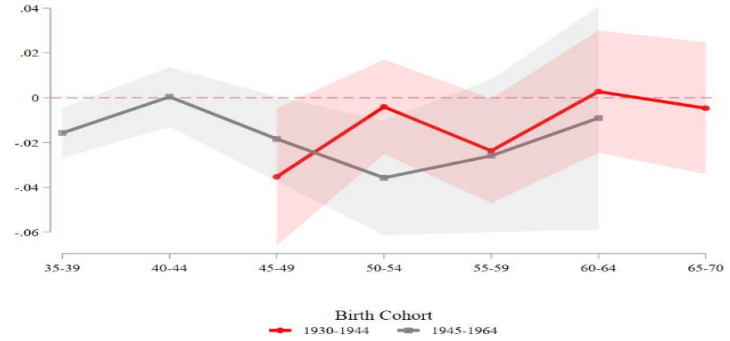
c: BA Degree or Greater – Less Than HS Degree



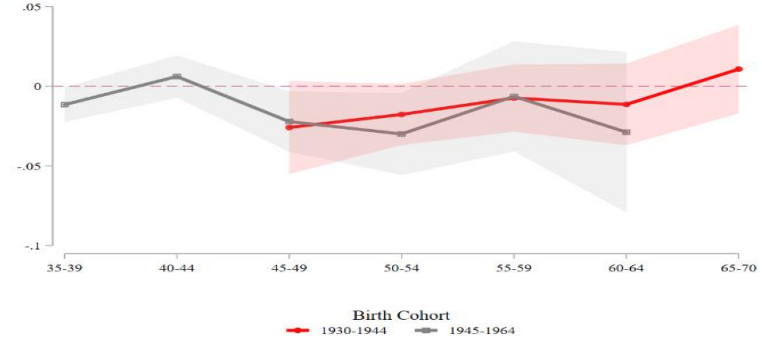
d: Some College – HS Degree



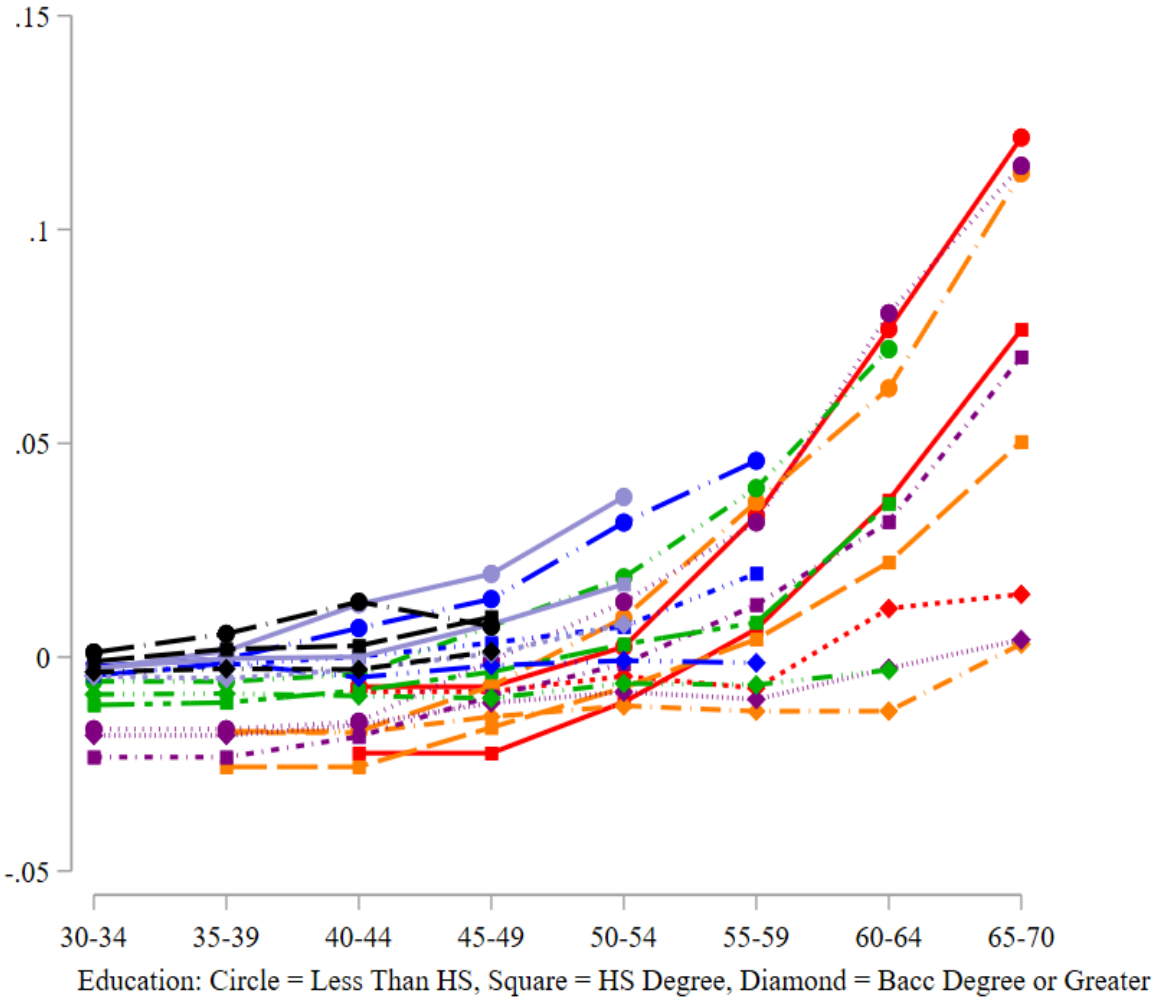
e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree



National Health Interview Survey 1976 to 2016
Proportion Widowed



National Health Interview Survey 1976 to 2016
Proportion Widowed

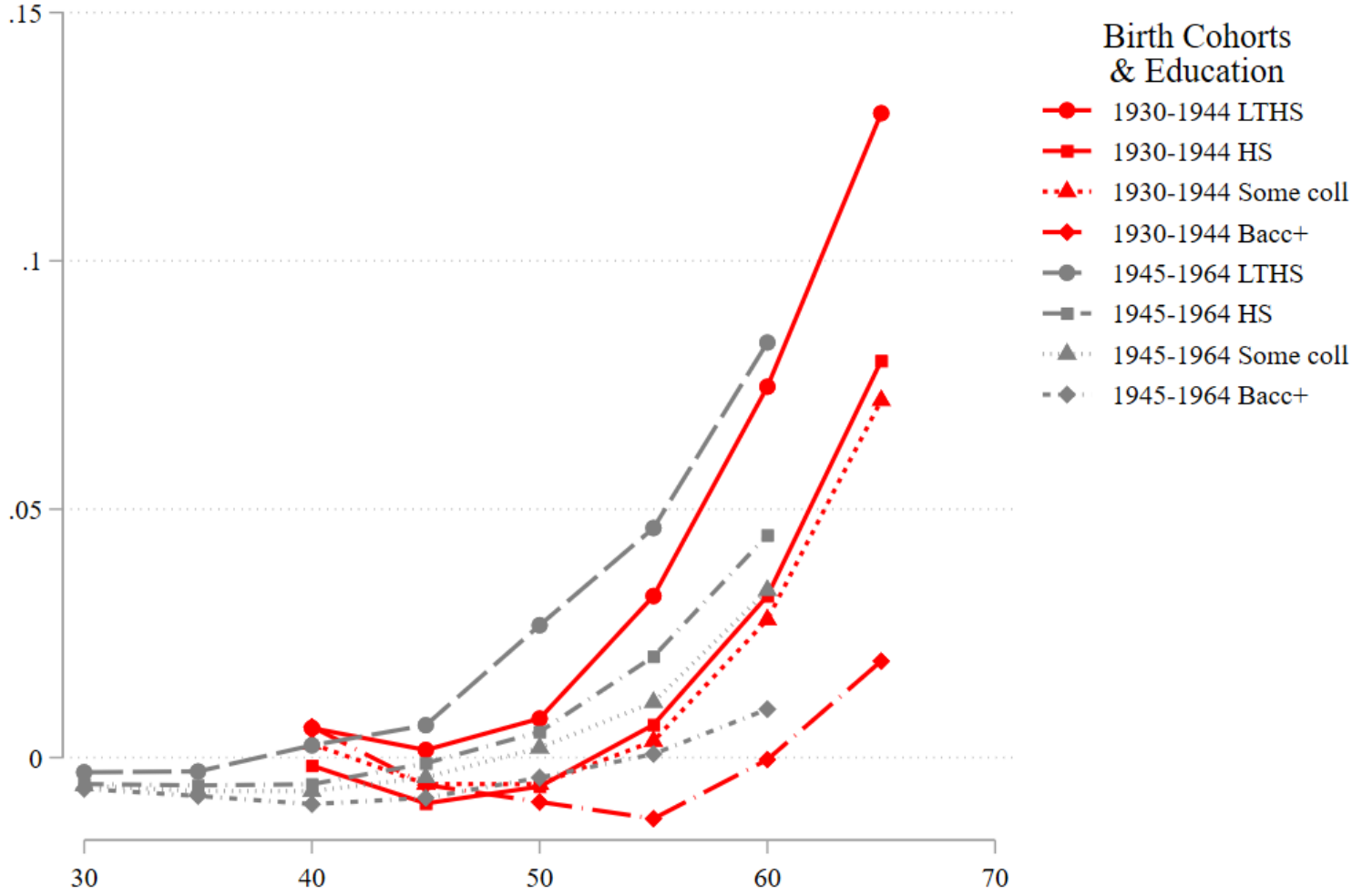
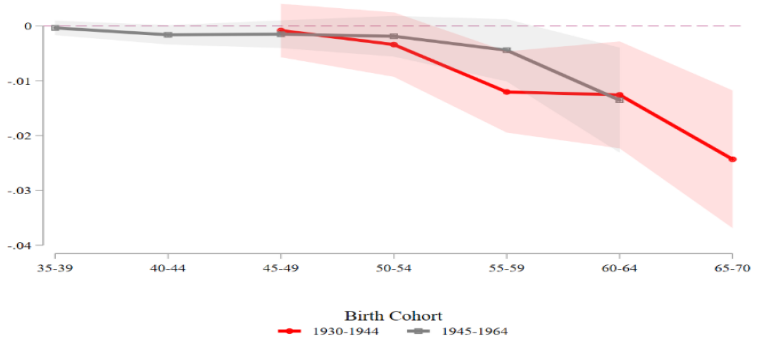
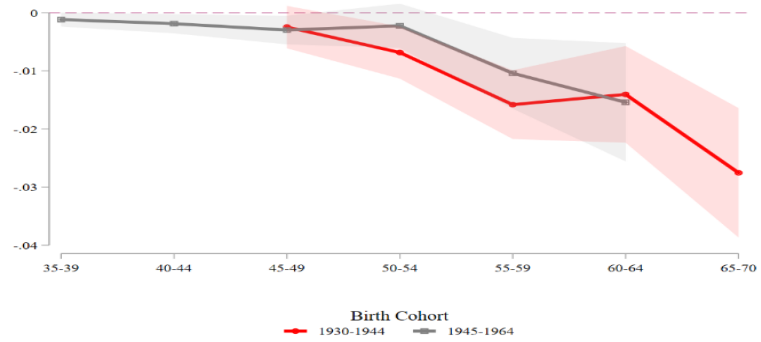


Figure 12: Differences-in-Differences Estimates of the Effect of Education on the Probability of Being Widowed by Age for Non-Hispanic, White NHIS Respondents

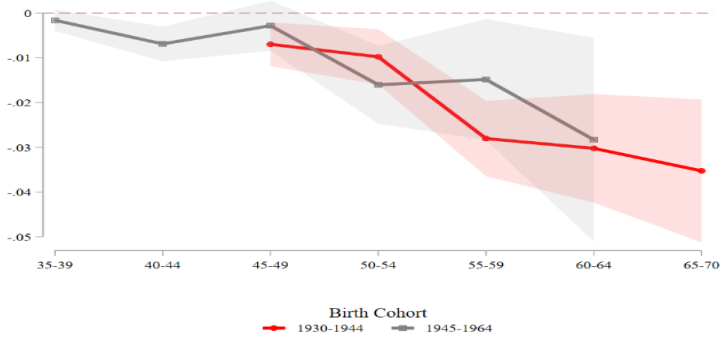
a: BA Degree or Greater – Some College



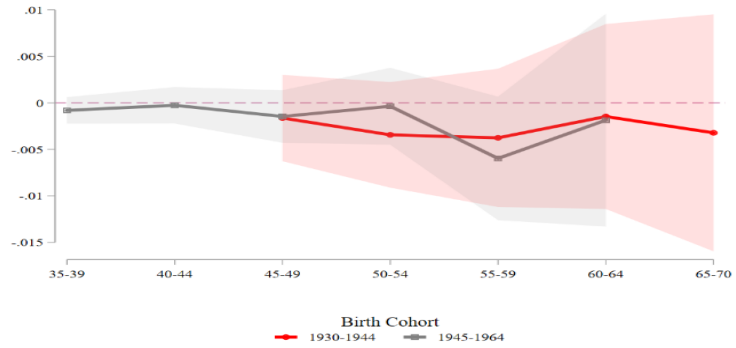
b: BA Degree or Greater – HS Degree



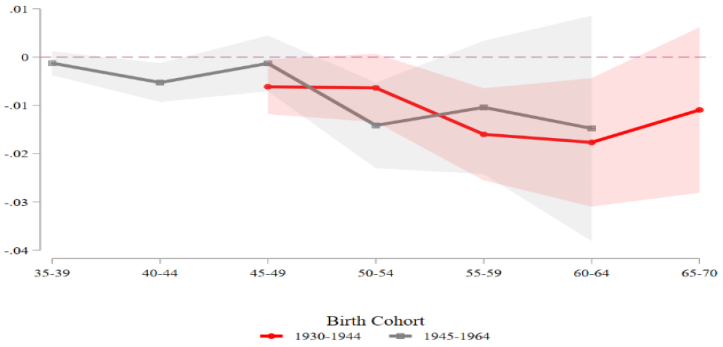
c: BA Degree or Greater – Less Than HS Degree



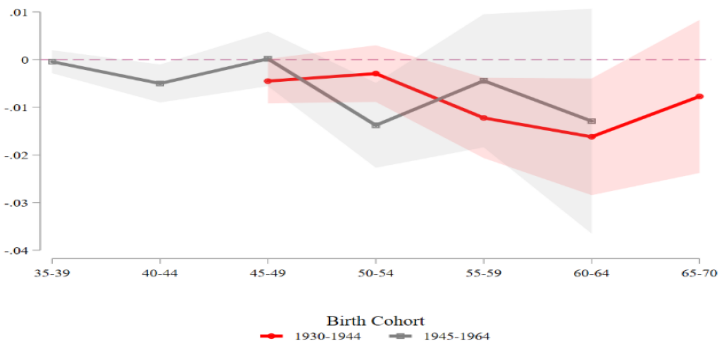
d: Some College – HS Degree



e: Some College – Less Than HS Degree



f: HS Degree – Less Than HS Degree



Summary of Results from NHIS Synthetic Cohorts

- Education is associated with better health as measured by: self-reported health, activity limitations, diabetes, and widowed
- Education effects manifest in mid 40s—a decade earlier than mortality
- Most of the effect of education is between those with less than a high school degree and others
- Some evidence of a diminishing of the education effect with age, which is consistent with a selective mortality explanation
- No consistent evidence of a changing relationship over time

National Longitudinal Survey 1979 Cohort

- Longitudinal data that has followed approximately 12,000 persons between the ages of 14 and 21 in 1979 to the present.

- Extensive information about demographic and socioeconomic characteristics, family background, educational attainment, cognitive (e.g., ASVAB test scores) and non-cognitive (e.g., self-esteem) attributes, work, marital history, fertility and many other aspects of a person's life.

- Survey collected information on health at ages 40 and 50, as measured by the following: self-reported health, depression (CESD instrument), and physical and mental health (SF-12 instrument sub-scales).

National Longitudinal Survey 1979 Cohort

Table 3. Descriptive Statistics NLSY79 at Age 40

Variable	Mean (s.d.)
SF-12 Physical Score	52.2 (7.7)
SF_12 Mental Score	53.1 (8.1)
CESD	3.28 (4.1)
Self-reported Health Not Good	0.40
Male	0.47
Non-Hispanic Black	0.30
Hispanic	0.18
High School Degree	0.44
Some College	0.24
Bachelor's Degree or more	0.19
AFQT Percentile Score	40.8 (28.8)
Rotter Score (4 to 16)	8.7 (2.4)
Self-Esteem Score (7 to 3)	22.3 (4.0)
Mother's Education High School	0.40
Mother's Education Some College	0.10
Mother's Education Bachelor's or more	0.08
Two Parent Family at Age 14	0.70
Mother Only Family at Age 14	0.16
Library Card in Household Growing Up	0.72
Magazine in Household Growing Up	0.58
Newspaper in Household Growing Up	0.76

National Longitudinal Survey 1979 Cohort

Table 6. Estimates of the Association between Education and the SF-12 Physical Health Summary Measure

	Difference Age 50 – Age 40			
High School	1.44** (0.38)	1.27** (0.39)	1.31** (0.39)	1.18* (0.41)
Some College	1.81** (0.42)	1.40** (0.44)	1.46** (0.45)	1.20* (0.48)
Bachelors Plus	3.19** (0.44)	2.57** (0.48)	2.66** (0.50)	2.22** (0.54)
Family Background Rotter, Self-Esteem AFQT	No No No	Yes No No	Yes Yes No	Yes Yes Yes
Number of Obs. Mean (sd) Dep. Var. For Omitted Group	5826	5826	5826	5826

National Longitudinal Survey 1979 Cohort

Table 7. Estimates of the Association between Education and the SF-12 Mental Health Summary Measure

	Difference Age 50 – Age 40			
High School	0.68* (0.40)	0.77 (0.41)	0.70 (0.41)	0.56 (0.43)
Some College	0.67 (0.44)	0.84 (0.43)	0.72 (0.47)	0.52 (0.50)
Bachelors Plus	0.92* (0.46)	1.19* (0.50)	1.02* (0.52)	0.85 (0.56)
Family Background Rotter, Self-Esteem AFQT	No No No	Yes No No	Yes Yes No	Yes Yes Yes
Number of Obs. Mean (sd) Dep. Var. For Omitted Group	5826	5826	5826	5826

National Longitudinal Survey 1979 Cohort

Table 8. Estimates of the Association between Education and the CESD Scale of Depression and Education

	Difference Age 50 – Age 40			
High School	-0.18 (0.19)	-0.27 (0.20)	-0.28 (0.20)	-0.32 (0.21)
Some College	-0.07 (0.21)	-0.17 (0.22)	-0.21 (0.22)	-0.25 (0.24)
Bachelors Plus	-0.23 (0.22)	-0.35 (0.24)	-0.39 (0.25)	-0.42 (0.27)
Family Background	No	Yes	Yes	Yes
Rotter, Self-Esteem	No	No	Yes	Yes
AFQT	No	No	No	Yes
Number of Obs.	5808	5808	5808	5808
Mean (sd) Dep. Var. For Omitted Group				

Summary of NLSY Results

- Education is associated with better physical health at ages 40-50
- Education does not have much of an effect on mental health at these ages
- The difference is consistent with the absence of significant depreciation of mental health at these ages, and therefore the possibility of little investment and little scope for education to be significant
- Extrapolating estimates suggests larger effects of education on health at older ages than younger ages

Conclusions

- The conceptual model highlights that education is likely to have different effects on health by age

- The conceptual model also highlights the key role of depreciation of health in the relationship between education and health—without depreciation there is little incentive to invest in health and without investment there is little scope for education to be significant

- In economics, there are almost no studies that allow the effect of education to differ by age—sociologists and demographers have conducted such analyses, but fail to embed the analyses in a well-specified conceptual model

- Failure to consider age and cohort effects bias estimates of the effect of education on health

Conclusions

- Evidence of a beneficial effect of education on mortality, but not until age 55
- Most of the differences in mortality by education are between those with less than a high school degree and other groups; among those with a high school degree or more there were modest differences in mortality
- Little evidence of a widening of education-mortality gradient between 1927 and 1945 cohorts
- Evidence that education has beneficial effect on self-reported poor health; any reported limitation; diabetes and being widowed
- Again, education effect is mainly between those with less than a high school degree and others
- Education effects for morbidity manifest in late 40s- a decade earlier than mortality
- Some evidence of selective mortality and its potential confounding influence
- In analyses that analyzed mental health, education had few effects at age 40-50