Health, Gender and Mobility: Intergenerational Correlations in Longevity over Time

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Motivation

- Existing mobility measures have a variety of shortcoming in terms of interpretation and comparison across groups (particularly gender) and over time
- Modern intergenerational income elasticities cannot be estimated for historical time periods and are often sensitive to transitory fluctuations in economic status
- Historical studies have been limited to occupational mobility which limits the samples that can be studied and has ambiguous welfare implications of observed mobility rates
- This paper takes an alternative path to estimate mobility through long term health outcomes addressing many of the limitations of occupational and income mobility studies

Brief overview of paper

- Existing mobility measures suggest a decline in American mobility over the past 150 years
- It is still unknown whether this decline existed for females as well as males and how the decline translated into persistence of welfare across generations
- This paper creates a new intergenerational dataset of linked death certificates that allows for estimating intergenerational correlations in longevity
- Longevity is correlated with occupational status both in terms of a child's occupation and father's occupation
- I find strong intergenerational longevity elasticities for both males and females
- These elasticities have been getting stronger for males over the past century but have been stable for females

Measures of modern income mobility

- Common approach is to measure intergenerational income elasticities:

$$\ln y_s = \alpha + \rho \ln y_f + ...$$

- Elasticities typically found to be in the 0.2-0.5 range (see Solon (1999) for survey of estimates)
- Female mobility estimates compare household income of a daughter to household income of parents, ρ looks slightly smaller for females

Measures of modern income mobility

Drawbacks of intergenerational income elasticities:

- Sensitive to transitory fluctuations in income (this can have big effects on estimates, see Mazumder (2005))
- Reliance on household income as a measure of individual welfare
- Lack of sufficient income data to estimate historical trends

Measures of historical occupational mobility

- Historical income data is rare
- Studies have relied on linking individuals across censuses and measuring occupational transitions
- Results suggest that US exhibited high levels of occupational mobility in the 19th century that have fallen over time (Ferrie (2005), Ferrie and Long (2006, 2009))

Measures of historical occupational mobility

Drawbacks of intergenerational occupational mobility:

- Difficult to translate occupational status to well being
- Major changes in occupational structure and nature of occupations over time
- Occupational change over career
- Difficult to interpret historically for females
- Strategy can't be used for females due to changing surnames

Motivating health as a measure of mobility

- Annual income and occupation are imperfect measures of long term economic status
- Both suffer from the effects of intragenerational mobility
- Both have issues of how to treat the spouse's income and occupation
- Occupation in particular is difficult to map into overall welfare

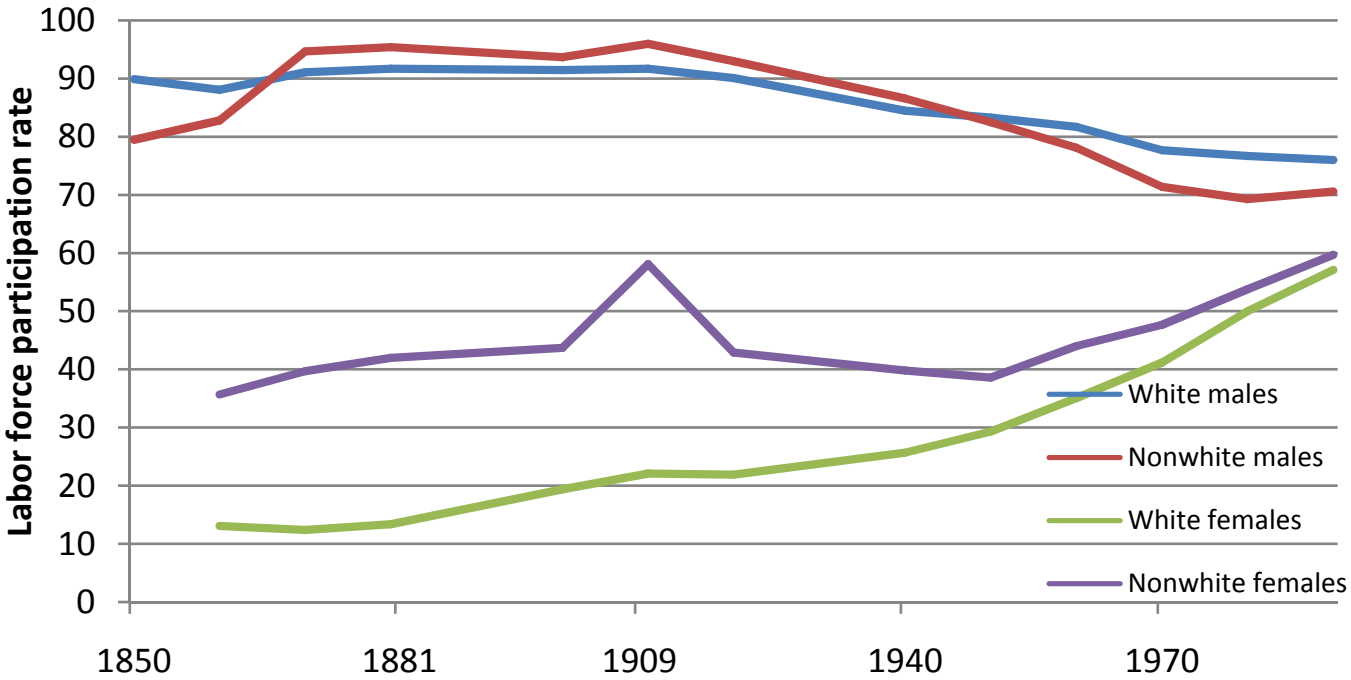
Motivating health as a measure of mobility

- A greater concern for our purposes is the inability of these measures to address female mobility
- Income mobility based on household income is a tricky measure of female welfare if the distribution of household resources (and work) is changing over time
- Occupational mobility based on female occupation has clear problems if looking at historical mobility patterns
- Occupational mobility based on spouse occupation is limited by surname changes

Why should we care about separate female mobility estimates?

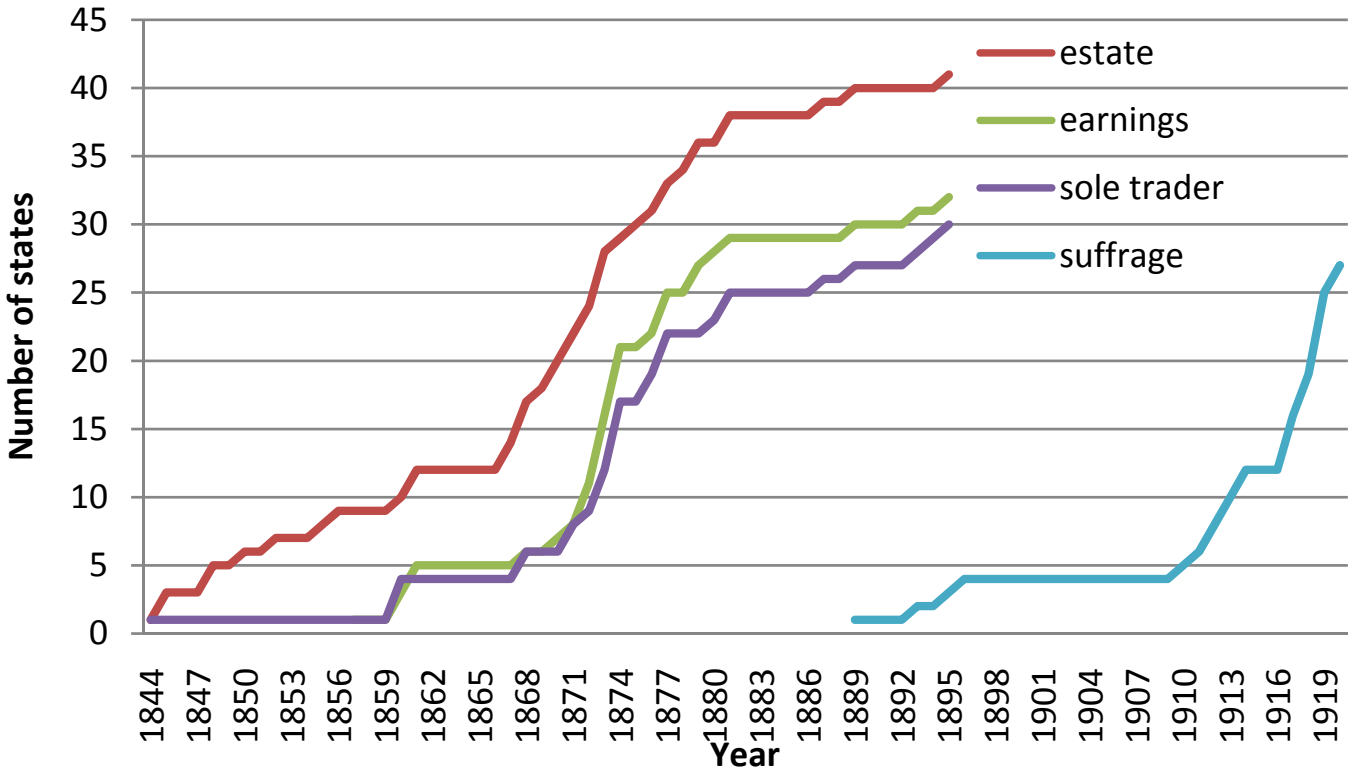
- The obvious: females are half the population
- More importantly, there are a variety of reasons we would expect historical mobility patterns of females to differ from the historical mobility patterns of males
- The forces shaping the economic status of women and men have followed very different paths historically

Why should we care about separate female mobility estimates?



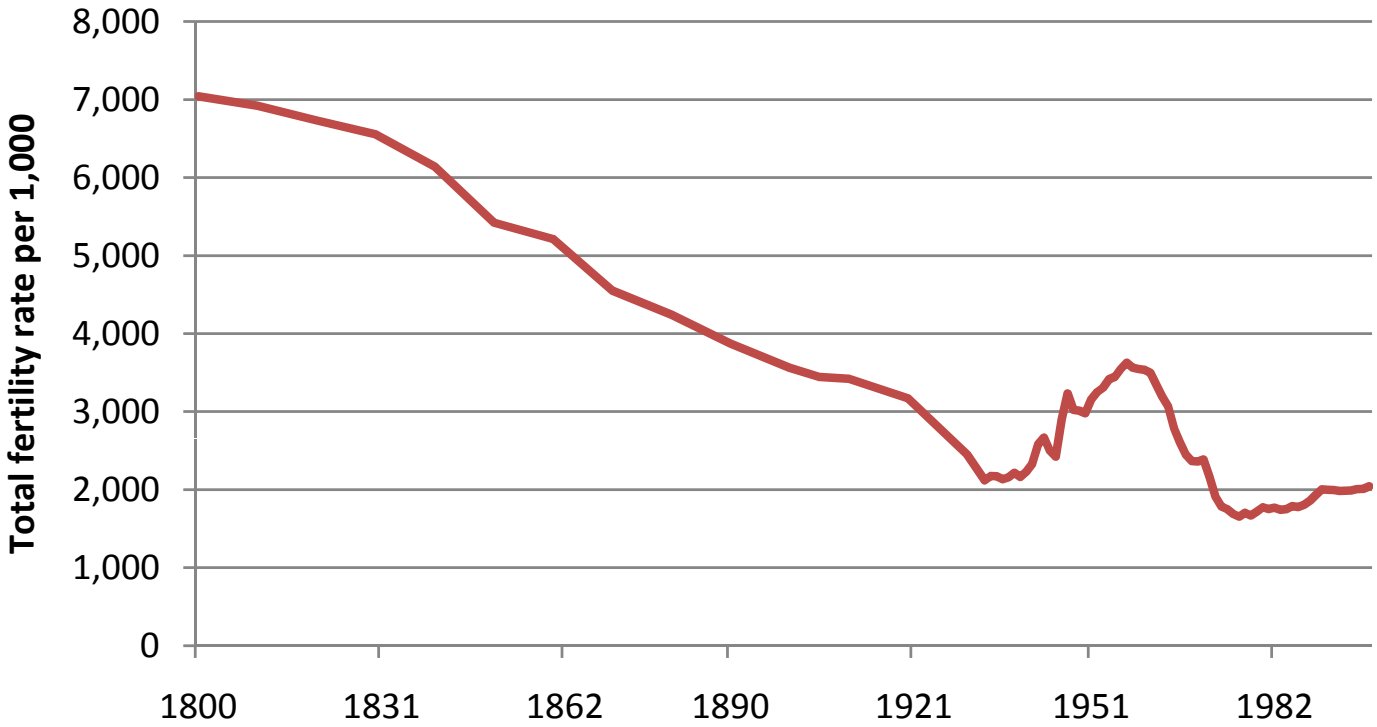
Labor force participation rates by gender and race, 1850-1990. Source: Sobek (2001).

Why should we care about separate female mobility estimates?



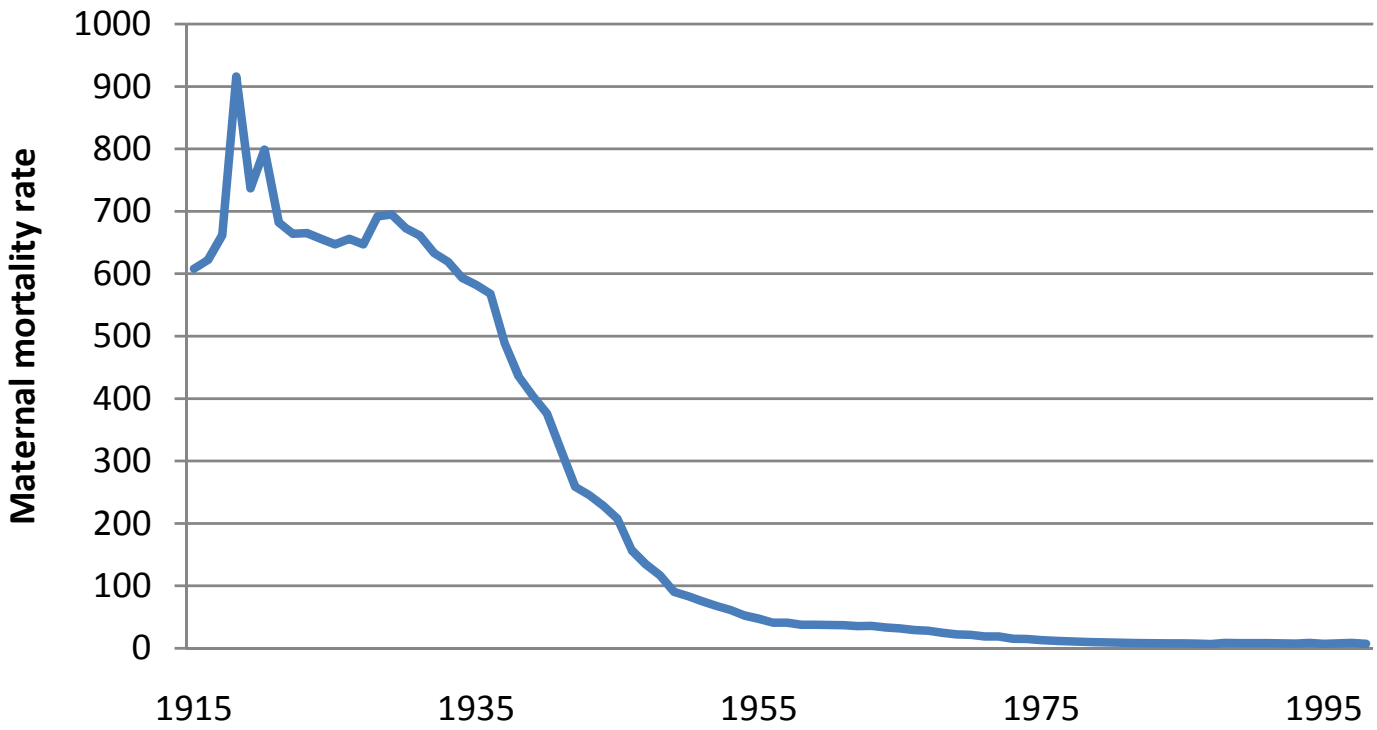
Number of states with women's property rights and suffrage laws, 1844-1920. Sources: Khan (1996), Rusk (2001).

Why should we care about separate female mobility estimates?



Total fertility rate per 1,000 for white females, 1800-1998.
Source: Historical Statistics of the United States.

Why should we care about separate female mobility estimates?



Maternal mortality rate per 100,000 live births, 1915-1998.
Source: US Public Health Service vital statistics.

Health as a measure of intergenerational mobility

The theoretical appeal of long term health outcomes as a measure of mobility:

- Long term health is a direct measure of quality of life, not a measure of a means to a particular quality of life
- Health outcomes have a consistent metric that allows for meaningful comparisons over time and across gender
- Health outcomes are individual outcomes (we don't need to understand how the allocation of household resources works)
- Lexicographic nature of health and economic success: health is a first order concern

Health as a measure of intergenerational mobility

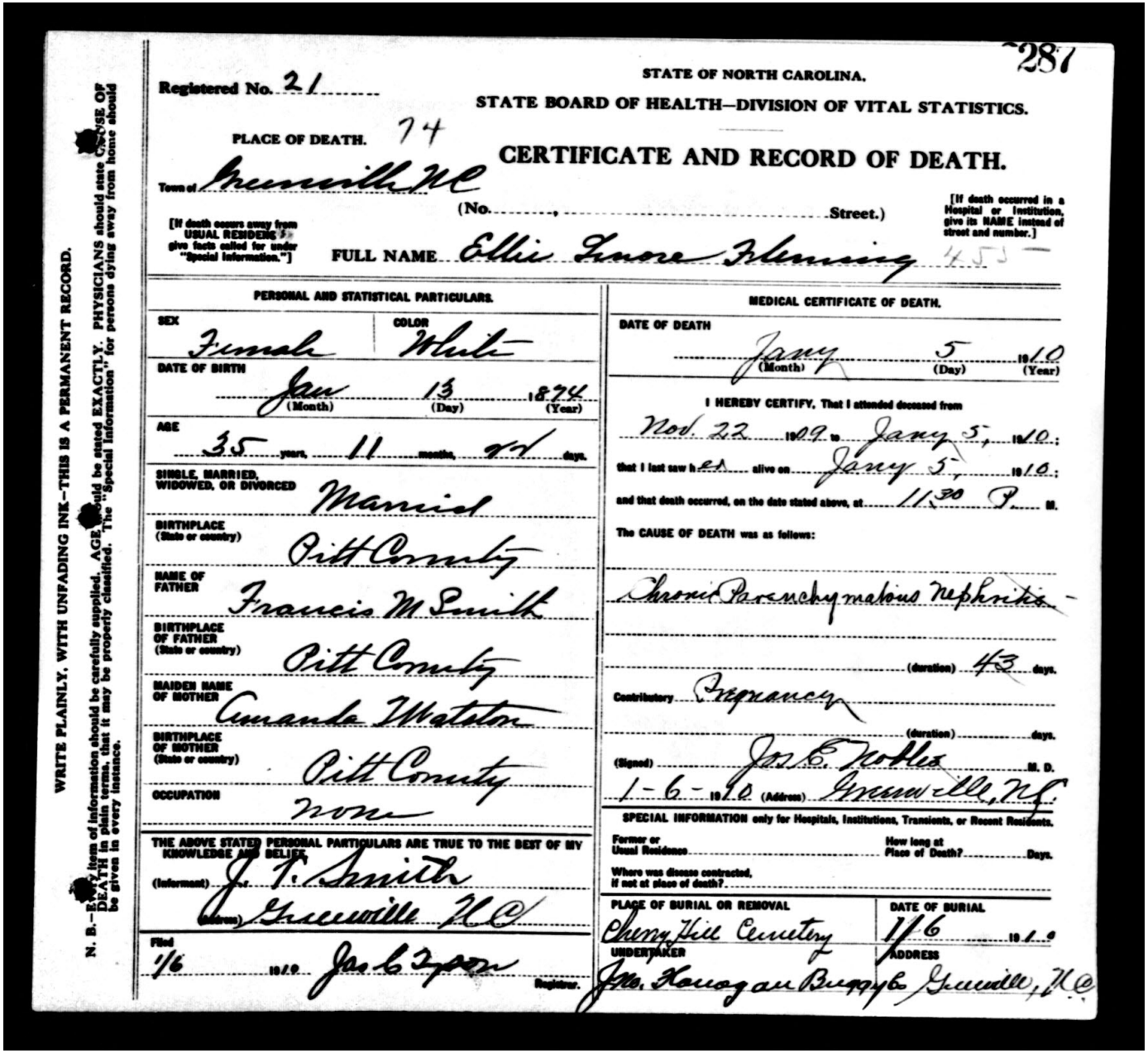
The practical appeal of long term health outcomes as a measure of mobility:

- Historical evidence on certain health outcomes is more prevalent than income and wealth data
- Annual data rather then decennial data
- Less affected by transitory fluctuations over life cycle
- Reported for males and females
- Better reporting of parental information

Death certificates as a data source

- The basic approach will be to match the death certificates of parents and children
- Death certificates have several useful features:
  - Cover entire state populations
  - Extend back to the 19th century for several states
  - Contain excellent long term health data and occupation information
  - More detailed information for linking than the census provides
- Focus for initial study will be the death certificates for Mecklenburg County, NC
  - North Carolina has detailed death records available from 1909 to 1975
  - Mecklenburg has significant urban and rural populations
  - Initial sample is a 10% sample of deaths in the county

North Carolina death certificate, 1910



STATE OF NORTH CAROLINA.

STATE BOARD OF HEALTH—DIVISION OF VITAL STATISTICS.

Registered No. 21 — 287

PLACE OF DEATH. 74

Town of Greenville NC

CERTIFICATE AND RECORD OF DEATH.

(No. ..... Street.)

[If death occurs away from USUAL RESIDENCE give facts called for under "Special Information."]

[If death occurred in a Hospital or Institution, give its NAME instead of street and number.]

FULL NAME Ellie Lenore Fleming

WRITE PLAINLY, WITH UNFADING INK—THIS IS A PERMANENT RECORD.

N. B.—Every item of information should be carefully supplied. AGE should be stated EXACTLY. PHYSICIANS should state CAUSE OF DEATH in plain terms, that it may be properly classified. The "Special Information" for persons dying away from home should be given in every instance.

PERSONAL AND STATISTICAL PARTICULARS.

SEX: Female

COLOR: White

DATE OF BIRTH: Jan (Month) 13 (Day) 1874 (Year)

AGE: 35 years, 11 months, 21 days.

SINGLE, MARRIED, WIDOWED, OR DIVORCED: Married

BIRTHPLACE (State or country): Pitt County

NAME OF FATHER: Francis M Smith

BIRTHPLACE OF FATHER (State or country): Pitt County

MAIDEN NAME OF MOTHER: Amanda Wooten

BIRTHPLACE OF MOTHER (State or country): Pitt County

OCCUPATION: none

THE ABOVE STATED PERSONAL PARTICULARS ARE TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

(Informant) J. T. Smith

(Address) Greenville NC

Filed 1/6 1910 Jas E Tyson Registrar.

MEDICAL CERTIFICATE OF DEATH.

DATE OF DEATH: Jany (Month) 5 (Day) 1910 (Year)

I HEREBY CERTIFY, That I attended deceased from Nov. 22 1909 to Jany 5, 1910;

that I last saw h.. alive on Jany 5, 1910;

and that death occurred, on the date stated above, at 11.30 P. M.

The CAUSE OF DEATH was as follows:

Chronic Parenchymatous Nephritis

(duration) 43 days.

Contributory Pregnancy

(duration) ..... days.

(Signed) Jas E Nobles M. D.

1-6-1910 (Address) Greenville, NC

SPECIAL INFORMATION only for Hospitals, Institutions, Transients, or Recent Residents.

Former or Usual Residence ..... How long at Place of Death? ..... Days.

Where was disease contracted, if not at place of death?

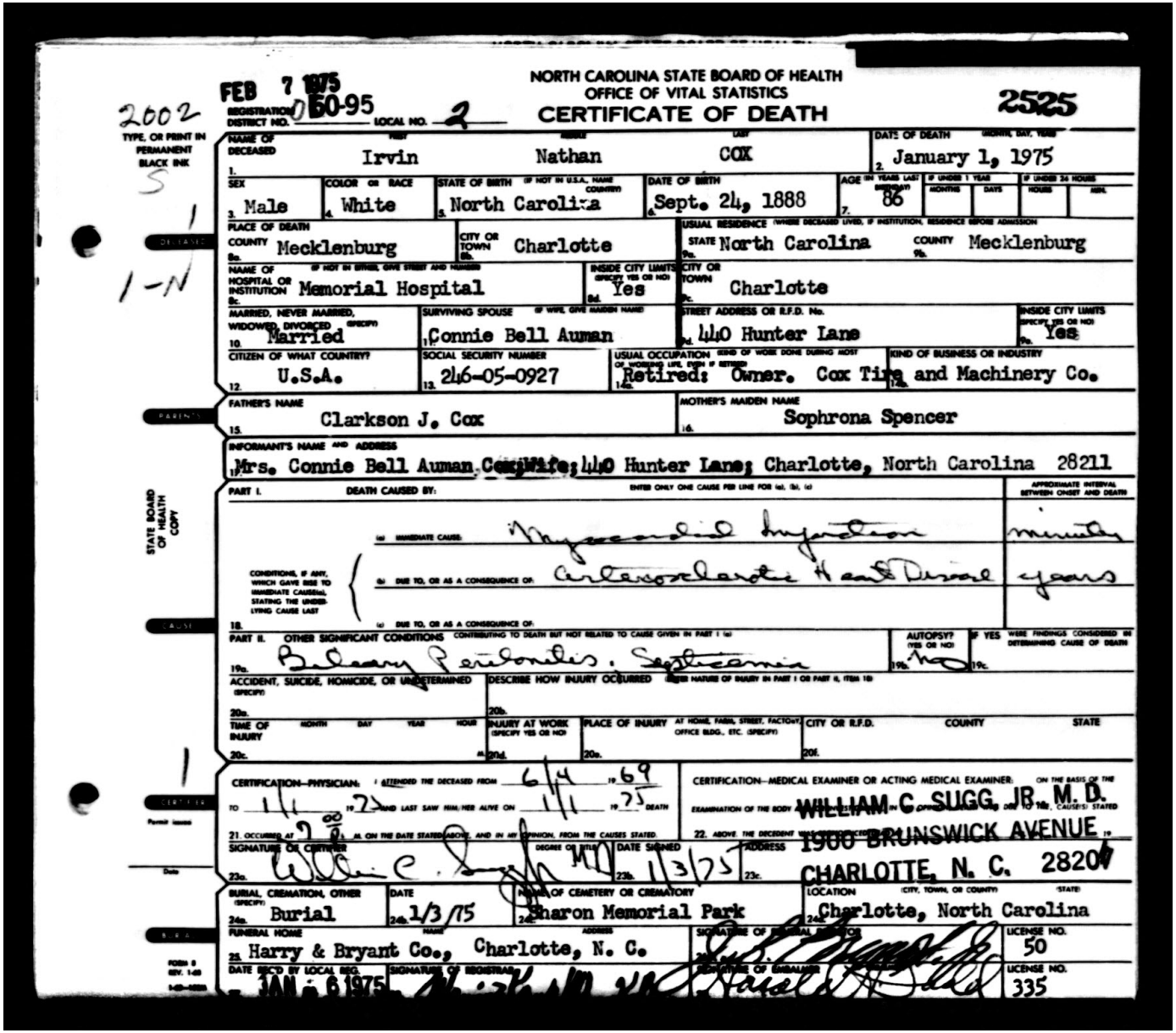
PLACE OF BURIAL OR REMOVAL: Cherry Hill Cemetery

DATE OF BURIAL: 1/6 1910

UNDERTAKER: Jno. Flanagan Buggy Co

ADDRESS: Greenville, N.C.

North Carolina death certificate, 1975



NORTH CAROLINA STATE BOARD OF HEALTH
OFFICE OF VITAL STATISTICS
CERTIFICATE OF DEATH

2525

2002

FEB 7 1975

REGISTRATION DISTRICT NO. 60-95 LOCAL NO. 2

TYPE, OR PRINT IN PERMANENT BLACK INK

1. NAME OF DECEASED: Irvin Nathan COX
2. DATE OF DEATH: January 1, 1975
3. SEX: Male
4. COLOR OR RACE: White
5. STATE OF BIRTH: North Carolina
6. DATE OF BIRTH: Sept. 24, 1888
7. AGE: 86
8a. PLACE OF DEATH: COUNTY Mecklenburg
8b. CITY OR TOWN: Charlotte
9a. USUAL RESIDENCE: STATE North Carolina
9b. COUNTY: Mecklenburg
8c. NAME OF HOSPITAL OR INSTITUTION: Memorial Hospital
8d. INSIDE CITY LIMITS: Yes
9c. CITY OR TOWN: Charlotte
10. MARRIED, NEVER MARRIED, WIDOWED, DIVORCED: Married
11. SURVIVING SPOUSE: Connie Bell Auman
9d. STREET ADDRESS OR R.F.D. No.: 440 Hunter Lane
9e. INSIDE CITY LIMITS: Yes
12. CITIZEN OF WHAT COUNTRY?: U.S.A.
13. SOCIAL SECURITY NUMBER: 246-05-0927
14a. USUAL OCCUPATION: Retired: Owner. Cox Tire and Machinery Co.
14b. KIND OF BUSINESS OR INDUSTRY:
15. FATHER'S NAME: Clarkson J. Cox
16. MOTHER'S MAIDEN NAME: Sophrona Spencer
17. INFORMANT'S NAME AND ADDRESS: Mrs. Connie Bell Auman, Wife; 440 Hunter Lane; Charlotte, North Carolina 28211

PART I. DEATH CAUSED BY: ENTER ONLY ONE CAUSE PER LINE FOR (a), (b), (c)

18. (a) IMMEDIATE CAUSE: Myocardial Infarction — minutes
(b) DUE TO, OR AS A CONSEQUENCE OF: Arteriosclerotic Heart Disease — years
CONDITIONS, IF ANY, WHICH GAVE RISE TO IMMEDIATE CAUSE(a), STATING THE UNDERLYING CAUSE LAST
(c) DUE TO, OR AS A CONSEQUENCE OF:

PART II. OTHER SIGNIFICANT CONDITIONS CONTRIBUTING TO DEATH BUT NOT RELATED TO CAUSE GIVEN IN PART I (a): Bilateral Pseudocysts. Septicemia
19a. AUTOPSY? (YES OR NO): No
19b. IF YES WERE FINDINGS CONSIDERED IN DETERMINING CAUSE OF DEATH?

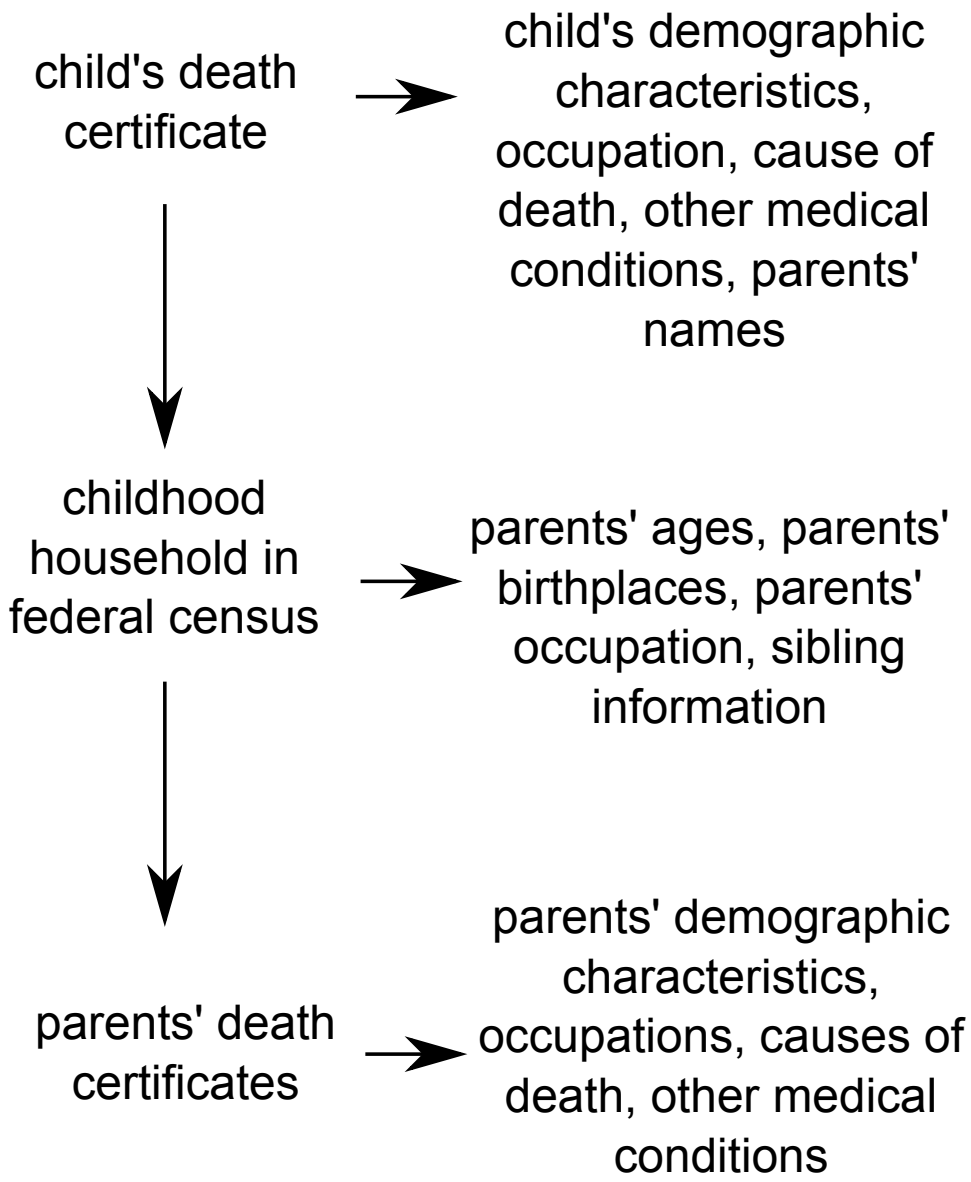
20a. ACCIDENT, SUICIDE, HOMICIDE, OR UNDETERMINED (SPECIFY)
20b. DESCRIBE HOW INJURY OCCURRED
20c. TIME OF INJURY: MONTH DAY YEAR HOUR
20d. INJURY AT WORK (SPECIFY YES OR NO)
20e. PLACE OF INJURY: AT HOME, FARM, STREET, FACTORY, OFFICE BLDG., ETC. (SPECIFY)
20f. CITY OR R.F.D. COUNTY STATE

CERTIFICATION—PHYSICIAN: I ATTENDED THE DECEASED FROM 6/4 19 69 TO 1/1 19 75 AND LAST SAW HIM/HER ALIVE ON 1/1 19 75 DEATH
21. OCCURRED AT 7:00 P.M. ON THE DATE STATED ABOVE, AND IN MY OPINION, FROM THE CAUSES STATED.
CERTIFICATION—MEDICAL EXAMINER OR ACTING MEDICAL EXAMINER: ON THE BASIS OF THE EXAMINATION OF THE BODY I HELD ON 19 DEATH OCCURRED AT THE TIME, DATE AND PLACE AND DUE TO THE CAUSE(S) STATED
22. ABOVE THE DECEDENT WAS PRONOUNCED DEAD AT THE TIME, DATE AND PLACE AND DUE TO THE CAUSE(S) STATED: WILLIAM C. SUGG, JR. M.D.
23a. SIGNATURE OF CERTIFIER: William C. Sugg MD
23b. DATE SIGNED: 1/3/75
23c. ADDRESS: 1900 BRUNSWICK AVENUE CHARLOTTE, N. C. 28207

24a. BURIAL, CREMATION, OTHER (SPECIFY): Burial
24b. DATE: 1/3/75
24c. NAME OF CEMETERY OR CREMATORY: Sharon Memorial Park
24d. LOCATION (CITY, TOWN, OR COUNTY) (STATE): Charlotte, North Carolina
25. FUNERAL HOME NAME: Harry & Bryant Co., ADDRESS: Charlotte, N. C.
LICENSE NO.: 50
DATE REC'D BY LOCAL REG.: JAN 6 1975
SIGNATURE OF REGISTRAR:
LICENSE NO.: 335

STATE BOARD OF HEALTH COPY

Linking children to their parents



Linking success rates

	All individuals	Males	Females
Number of individuals in initial sample	12,317	6,849	5,468
Number of individuals born before 1930	10,104	5,489	4,615
Linking child to federal census			
% of individuals born before 1930 not found in census	61.3%	60.8%	63.0%
% found but not living with parents	0.2	0.1	0.2
% found living with mother but not father	0.6	0.5	0.2
% found living with father but not mother	0.3	--	0.1
% found living with both parents	37.6	38.5	36.5
Linking parents to death certificates			
% of individuals found in census linked to father's death certificate only	18.6%	20%	17.2%
% linked to mother's death certificate only	17.9	18.7	17.4
% linked to both parents' death certificates	20.1	20.2	17.6
Number of individuals matched to at least one parent's death certificate	1521	872	649

Characteristics by linking outcome

	Sons		Daughters	
	Not matched to either parent	Matched to at least one parent	Not matched to either parent	Matched to at least one parent
Mean life span	58.6	60.9	61.9	64.7
Standard deviation of life span	(20.0)	(15.8)	(21.5)	(17.3)
% born in North Carolina	56%	83%	56%	80%
% born in South Carolina	23	8	23	12
% in farming	15	17	2	0.4
% in skilled/semi-skilled occupations	23	26	26	30
% in textiles	14	15	8	11
% in unskilled occupations	21	8	52	33
% in white collar occupations	28	35	13	26

Measures of health from death certificates

The standard information on the death certificates offers several ways to measure health:

- Date of death and date of birth allow for direct calculation of life span
- Interval between onset and death for medical conditions allows for calculating healthy life span (or years in poor health)
- Cause of death and other significant conditions allow for disease-specific measures:
  - Disease incidence
  - Age at incidence
  - Duration of disease
- All of these measures can be calculated for children and their parents

Measures of health from death certificates

The initial results will focus on longevity. While this is the simplest measure to begin with, even longevity has a few complicating factors:

- There are two different ways to calculate longevity: using the date of birth given on the death certificate or using the age given on the federal census
- In a perfect world, these would give the same result but in practice they are often different
- This suggests a measurement error problem that will bias any intergenerational elasticities toward zero
- If one birth year is better than another, we should discard the poor one
- If both are equally likely to be misreported, we should average the two

Age misreporting by gender and race

	Death certificate birth year - census birth year			Absolute value of (death certificate birth year - census birthyear)		
	Child	Mother	Father	Child	Mother	Father
All	-.29	-.58	-.44	.98	1.61	1.55
	(1.58)	(2.45)	(2.45)	(1.27)	(1.93)	(1.95)
Male	-.39	-.57	-.53	.96	1.66	1.54
	(1.47)	(2.46)	(2.42)	(1.17)	(1.89)	(1.94)
Female	-.21	-.59	-.38	.98	1.59	1.53
	(1.62)	(2.48)	(2.43)	(1.31)	(1.99)	(1.93)
White	-.47	-.79	-.57	.83	1.41	1.42
	(1.20)	(2.05)	(2.20)	(.99)	(1.68)	(1.77)
Black	.56	1.08	.48	1.73	3.39	2.68
	(2.55)	(4.21)	(3.85)	(1.95)	(2.71)	(2.94)

Notes: Census birth year is calculated by subtracting the age reported in the census from the year of the census. This means that the imputed birth year may be one year off of the death certificate birth year simply because the individual has not reached their birthday by the time of the census.

Age heaping by gender and race

Percentage of observations with a last digit of 0 or 5

	Child's census age	Father's census age	Mother's census age	Child's death certificate birth year	Father's death certificate birth year	Mother's death certificate birth year
All	18.7%	24.4%	23.7%	20.4%	18.6%	19.7%
Male	17.8	24.3	23.0	19.3	17.3	20.6
Female	19.9	24.5	24.6	18.5	20.6	18.6
White	18.9	23.4	22.9	19.5	18.7	19.7
Black	17.6	29.3	27.8	17.9	18.5	20.4

Male occupational distribution by cohort

	Distribution of ocupations within cohort			
Decade of birth	Farmer	Skilled, semi-skilled	Unskilled	White collar
1830s	67%	17%	0%	17%
1840s	75	16	4	5
1850s	68	11	3	19
1860s	69	11	8	12
1870s	57	16	8	18
1880s	44	22	10	24
1890s	30	27	11	32
1900s	19	24	11	45
1910s	10	45	10	34
1920s	5	35	10	50

Note: Distributions are based on all males in the sample including both fathers and male children.

Longevity and occupational status

Occupational category	Son's lifespan by son's occupation	Son's lifespan by father's occupation	Daughter's lifespan by father's occupation
Farmer	68.2	64.7	67.6
	(15.0)	(13.9)	(16.6)
Skill, semi-skilled	62.0	56.8	64.1
	(13.5)	(16.9)	(19.2)
Unskilled	51.7	53.2	55.4
	(17.8)	(18.1)	(17.5)
White collar	60.4	58.4	61.5
	(12.2)	(15.3)	(16.4)
Number of observations	360	414	316

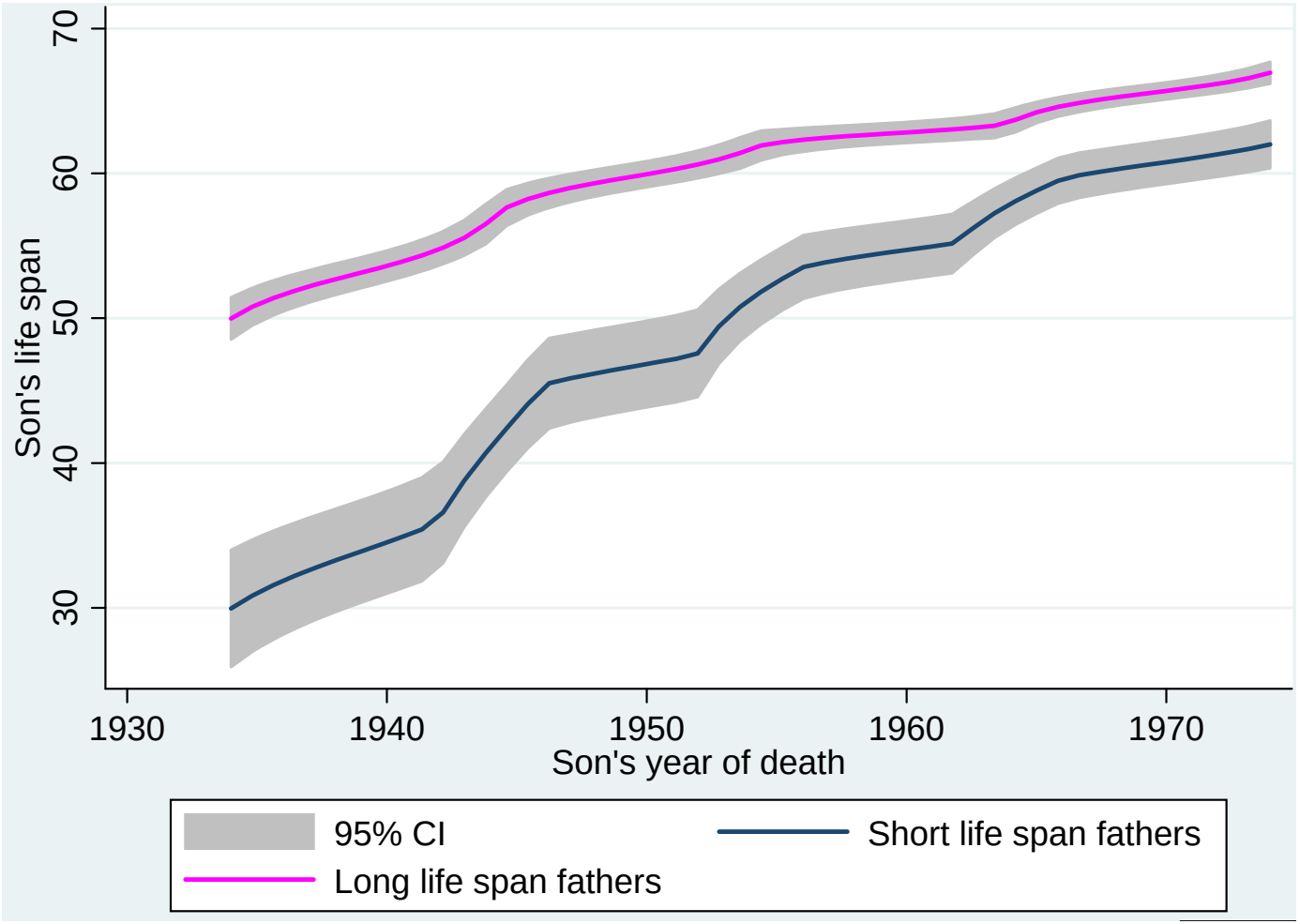
Notes: Standard deviations are given in parentheses. Lifespan is calculated using the year of death from the death certificate and the year of birth implied by the age given on the federal census.

Longevity and occupational status

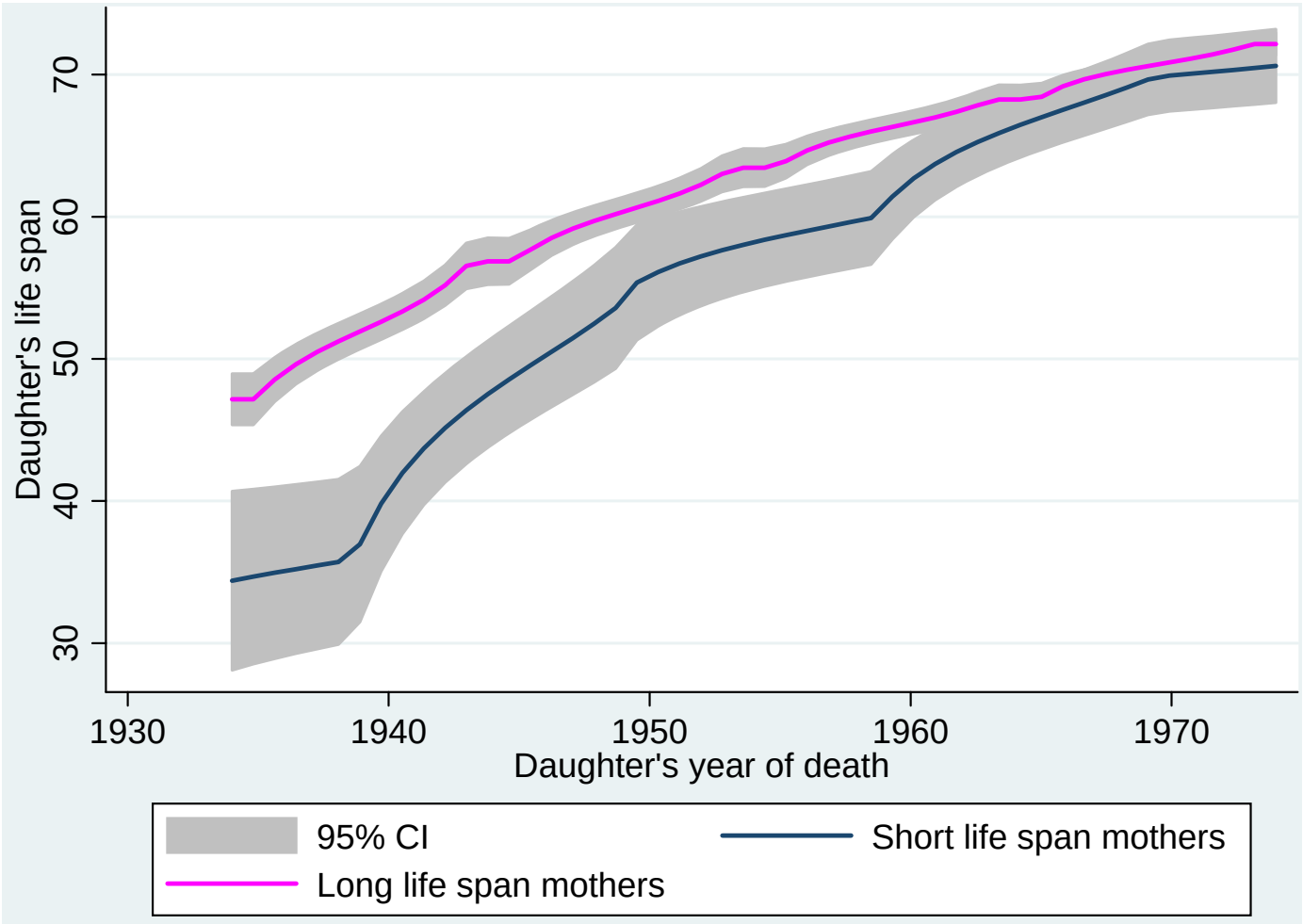
	Sons	Daughters
Child's birth year	26.157***	28.860***
	(8.842)	(10.879)
(Child's birth year)^2	-0.007***	-0.008***
	(0.002)	(0.003)
Son's occupation dummies		
Skilled/semi-skilled	2.818**	--
	(1.326)	--
White collar	1.026	--
	(1.243)	--
Unskilled	-8.419***	--
	(2.230)	--
Father's occupation dummies		
Skilled/semi-skilled	-2.260	-2.721
	(1.508)	(1.985)
White collar	-2.291	-1.339
	(1.561)	(1.793)
Unskilled	-4.494**	-4.426*
	(2.140)	(2.502)
Constant	-24,111.147***	-26,560.912**
	(8,398.513)	(10,330.568)
Observations	545	411
R-squared	0.44	0.47

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Ommitted occupational dummy is farmer for both son and father.

Intergenerational correlations in longevity



Intergenerational correlations in longevity



Estimating mobility with longevity

- Longevity offers us a nice, continuous variable that measures welfare
- To measure mobility with longevity, the same approaches used for modern income mobility studies can be applied
- The basic idea is to estimate an intergenerational life span elasticity:

$$\ln L_{i,c} = \alpha + \rho \ln L_{i,p} + X_i\beta + \varepsilon_i$$

- $L_{i,c}$ and $L_{i,p}$ are the life spans of the child and parent for observation i, respectively
- X_i includes a polynomial in the child's birth year and a polynomial in parent's birth year
- Sons and daughters are treated as separate samples

Intergenerational longevity elasticities for males

Estimates of intergenerational health elasticities for sons and their fathers, log of son's life span as the dependent variable.

	(1)	(2)	(3)
ln(father's life span)	0.283***	0.274***	0.214***
	(0.063)	(0.066)	(0.075)
Son's birth year	0.995***	0.692***	0.634**
	(0.183)	(0.245)	(0.247)
(Son's birth year)^2	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Father's birth year		0.362*	0.257
		(0.190)	(0.200)
(Father's birth year)^2		-0.000*	-0.000
		(0.000)	(0.000)
ln(Father's life span) x (son's birth year-1900)/10			0.093*
			(0.056)
Constant	-930.676***	-980.706***	-789.322***
	(174.020)	(175.897)	(210.251)
Observations	586	586	586
R-squared	0.38	0.38	0.38

Notes: Standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Intergenerational longevity elasticities for females

Estimates of intergenerational health elasticities for daughters and their mothers, log of daughter's life span as the dependent variable.

	(1)	(2)	(3)
ln(mother's life span)	0.185***	0.203***	0.210***
	(0.061)	(0.064)	(0.068)
Daughter's birth year	0.795***	0.760***	0.772***
	(0.176)	(0.274)	(0.277)
(Daughter's birth year)^2	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Mother's birth year		0.053	0.080
		(0.246)	(0.258)
(Mother's birth year)^2		-0.000	-0.000
		(0.000)	(0.000)
ln(mother's life span) x (daughter's birth year-1900)/10			-0.019
			(0.055)
Constant	-737.596***	-754.574***	-799.105***
	(167.016)	(170.256)	(215.053)
Observations	425	425	425
R-squared	0.41	0.41	0.41

Notes: Standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Intergenerational longevity elasticities using both parents' life spans

Life span regressions including both parent's life spans, log of child's life span as dependent variable.

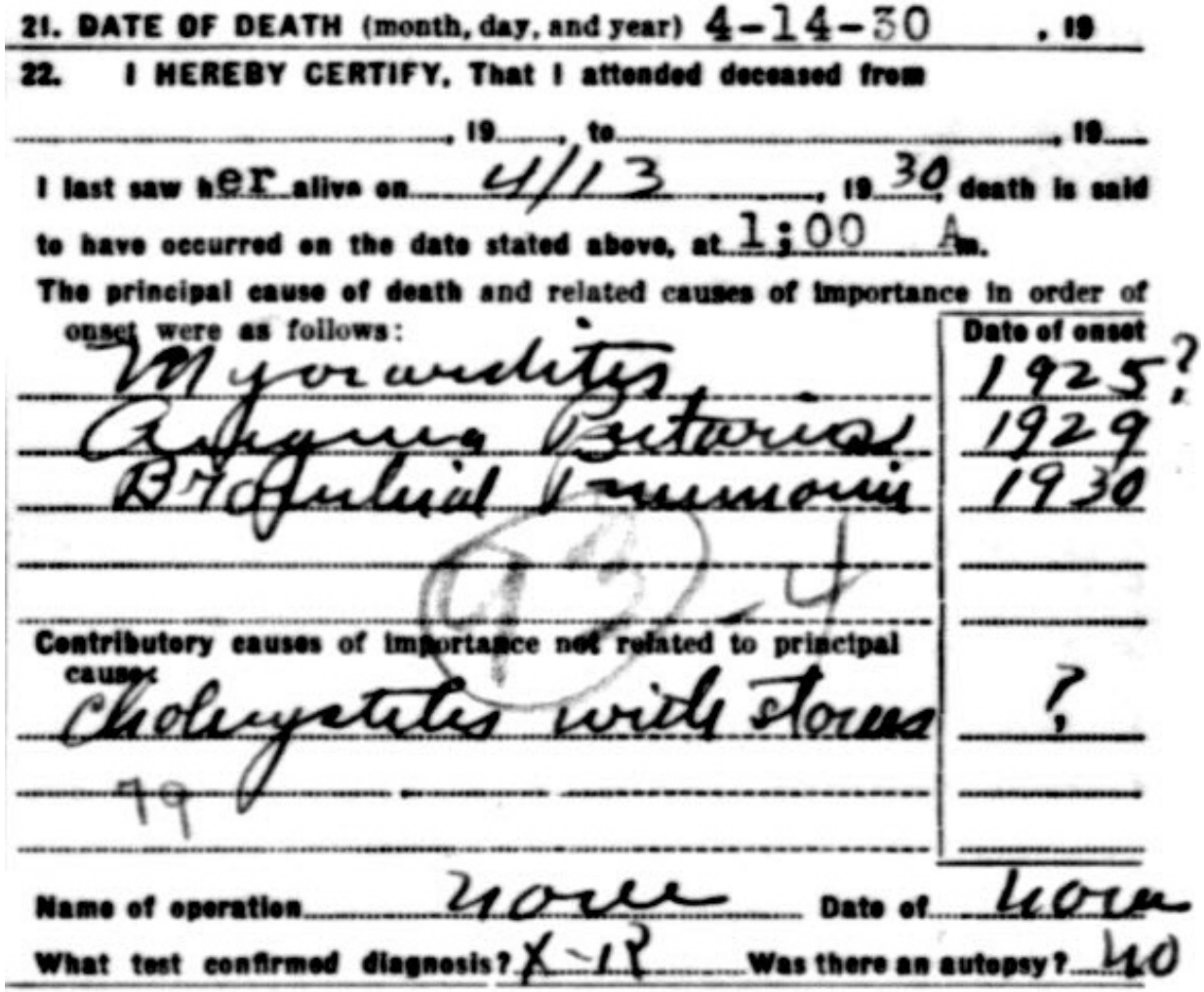
	Sons	Daughters
ln(father's life span)	0.359***	0.090
	(0.082)	(0.095)
ln(mother's life span)	0.157**	0.320***
	(0.076)	(0.086)
Child's birth year	1.516***	0.805**
	(0.279)	(0.362)
(Child's birth year)^2	-0.000***	-0.000**
	(0.000)	(0.000)
Constant	-1,427.452***	-749.339**
	(265.344)	(343.910)
Observations	293	215
R-squared	0.41	0.41

Notes: Standard errors in parentheses. * significant at 10%, ** signficant at 5%, *** significant at 1%.

Extensions: Coverage of sample

- Immediate task is to expand the sample coverage: more North Carolina counties, include South Carolina data, more observations at all years
- The larger sample will allow for looking at urban-rural differences and racial differences in mobility patterns
- Better coverage over time will allow for a better treatment of time trends in mobility (especially with regard to women's rights advances)
- If willing to focus only on health (not occupation) several other states can be added to the sample

Extensions: Healthy life span and years in poor health



21. DATE OF DEATH (month, day, and year) 4-14-30 , 19

22. I HEREBY CERTIFY, That I attended deceased from

, 19 , to , 19

I last saw her alive on 4/13 , 19 30 ; death is said to have occurred on the date stated above, at 1:00 A m.

The principal cause of death and related causes of importance in order of onset were as follows:

	Date of onset
Myocarditis	1925?
Arteriosclerosis	1929
Bronchial Pneumonia	1930

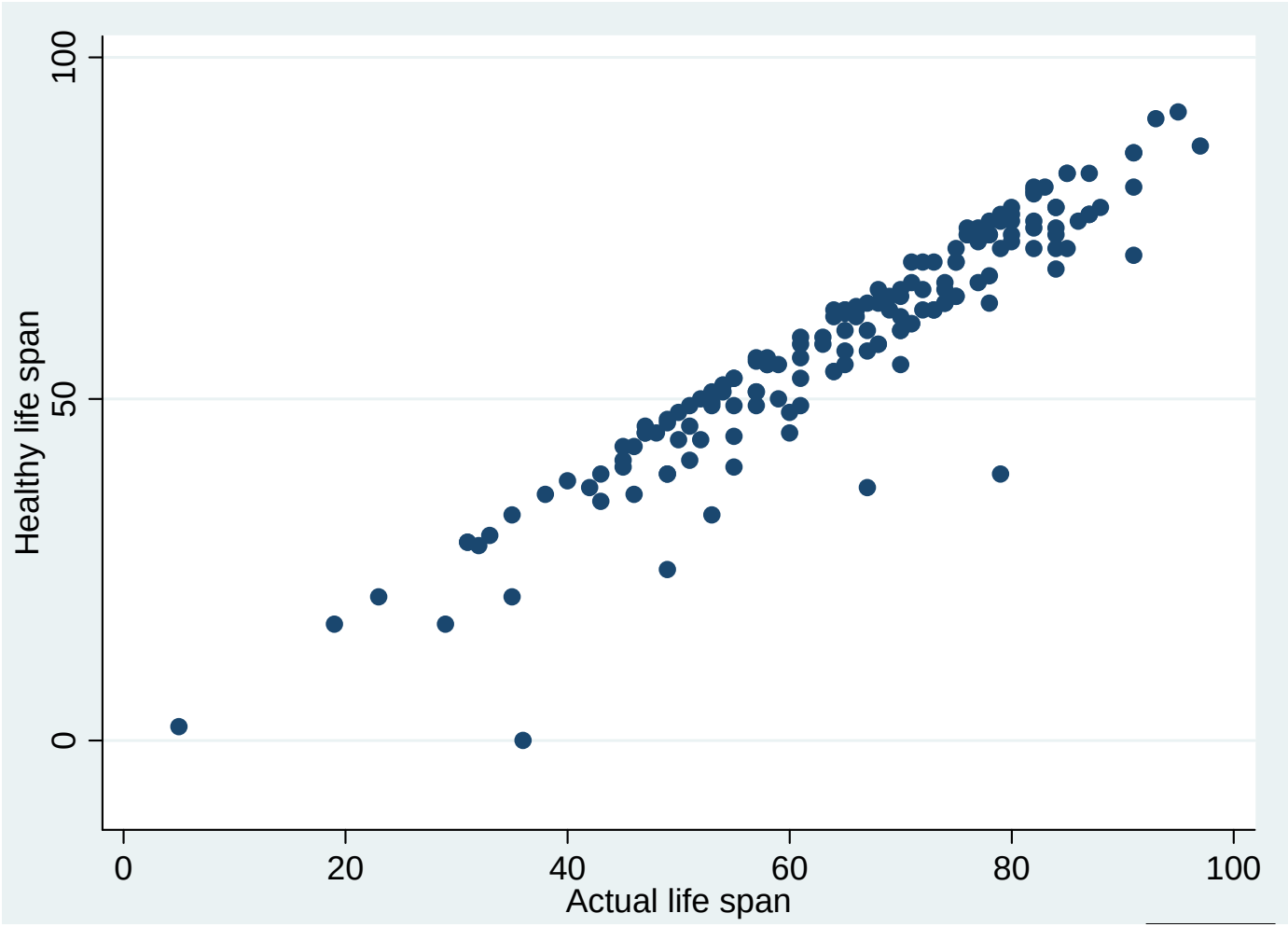
Contributory causes of importance not related to principal cause:

Cholecystitis with Stones	?

Name of operation None Date of None

What test confirmed diagnosis? X-Ray Was there an autopsy? No

Extensions: Healthy life span and years in poor health



Extensions: Linking to adult household

- The sons and daughters in our sample can be found as adults in the federal census searching by name, year of birth, state of birth and spouse's name
- Once linked to the federal census, we can add a variety of new variables:
  - Age at marriage
  - Age at first child
  - Number of children
  - Occupation and spouse's occupation
- This would allow for constructing occupational mobility measures for women using spouse's occupation and father's occupation
- Mobility rates could be explained as a function of marriage patterns, fertility patterns, and labor market decisions