Modern correlates of health

ECON 40565
Health Economics
Fall 2020

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Introduction

- Most of this class we will examine markets for medical care
  - How they operate
  - What are economic issues
- Medical care is however only interesting in that it is an intermediate product – used to produce what people care about – health
- This section – discuss what inputs can be transformed into health outputs

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Three main issues

- How is health measured?
- Some predictors of outcomes?
- Extended discussion about the role of socioeconomic status and health

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Aggregate measures of health

- Mortality rates
  - death per period among a define population
- Infant mortality rate
  - deaths 1st year of life/births
  - Neonatal mortality: deaths 1st 28 days
- Life expectancy
  - At birth
  - Conditional on a particular age

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Self-reported health status

- Benefits
  - Easy/low cost variable to collect
  - Predicts other measures of health that are difficult to collect
- Shortcomings
  - No way to compare people
  - No way to compare aggregate data across countries
  - May be difficult to compare groups over time
    - Rise in disability
    - "Harvesting"

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% Reporting Health Status, Males

Health	Age 30-44	Age 45-64	Age 65-74
Excellent	43.7%	30.6%	18.1%
Very good	30.3%	26.9%	22.5%
Good	19.8%	26.1%	31.6%
Fair	4.7%	10.6%	18.5%
Poor	1.5%	5.8%	9.3%

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5-Year Mortality Rate, Males

Health	Age 30-44	Age 45-64	Age 65-74
Excellent	0.7%	2.4%	8.6%
Very good	0.9%	2.9%	10.9%
Good	1.6%	5.2%	16.7%
Fair	2.9%	11.7%	25.2%
Poor	10.4%	22.8%	42.9%

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5-Year Mortality Rate, Females

Health	Age 30-44	Age 45-64	Age 65-74
Excellent	0.3%	1.7%	5.6%
Very good	0.4%	1.9%	6.3%
Good	0.9%	2.9%	8.8%
Fair	1.8%	6.2%	14.1%
Poor	7.1%	15.6%	32.2%

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Biomarkers

- Mortality limited for some populations
- SRHS difficult to compare across people
- Objective way to measure health status across people?
- Biomarkers
  - Clinical markers of physiology
  - Predictive of future health outcomes
  - Measurable across people
  - Easily collect

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Examples

- Blood pressure
  - High BP can lead to stroke, AMI, heart failure, kidney failure
- Cholesterol
  - HDL, LDL and total
  - High chol. can lead to heart attack
- Resting heart rate
- Glycated hemoglobin
  - Predictor of diabetes,
- Body mass index (kg's/cm^2)
  - Increased risk of diabetes
  - High BMI correlated w/ increased mortality

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Mortality rates in the 20th century

- Tremendous changes in aggregate statistics
- Two halves
  - Decline in infant deaths (1/2 half) and infections
  - Conquering cardiac disease

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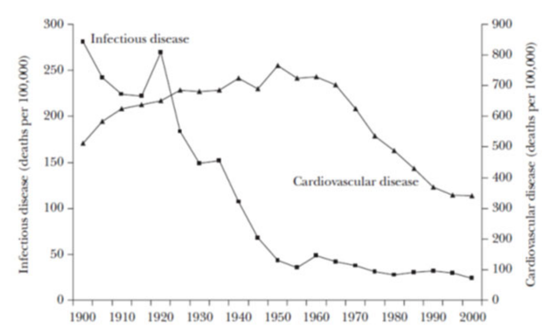
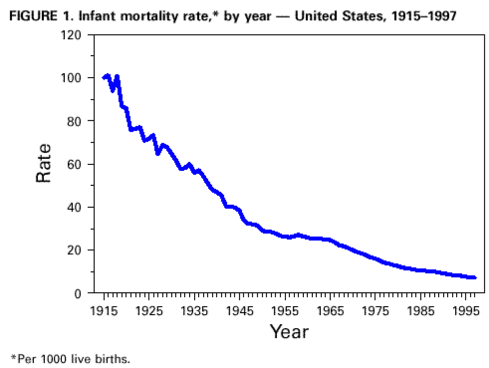
Figure 3

Mortality From Infectious Disease and Cardiovascular Disease, United States, 1900–2000



Source: Data are from the Centers for Disease Control and Prevention, National Center for Health Statistics, and are age adjusted.



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What causes big changes in life expectancy?

- Most deaths are to the elderly
- But, when an infant dies, you add a small number to the numerator in a life expectancy calculation
- Big changes will be generated by
  - Changes in the infant mortality rate
  - Changes in mortality for the elderly which are a large fraction of deaths

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Distribution of Deaths by Age

Age of	Fraction deaths
<1	1.0%
1-14	0.3%
15-24	1.1%
25-34	1.7%
35-44	2.8%
45-54	7.3%

Age	Fraction deaths
55-64	12.9%
65-74	16.5%
75-84	24.9%
85+	31.3%

72.7% of deaths are to people aged 65+

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Numeric Example

- Population with 100 people
- 10% die at age 1
  - ~ the 1900 infant mortality rate)
- If they survive, they live to age 75
- Life expectancy = (.1)(1) + (.9)(75) = 67.6
- Suppose infant mortality rates drops to 1%
  - ~ the 1980 Infant mortality rate
- Life expectancy = (0.01)(1) + (.99)(75) = 74.3

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Describing determinants of mortality in a cross section

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Vital Statistics, 2016

- 323 million people
- ~3.9 millions births
- ~2.7 million deaths

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Leading Causes of Death, 2016

• Heart disease	633,842
• Cancer	595,930
• Accidents	146,571
• Chronic lower resp. disease	155,041
• Stroke	140,323
• Alzheimer's	110,561
• Diabetes	79,535
• Influenza/Pneumonia	57,062
• Nephritis	49,959
• Suicide	44,193

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10 Leading Causes of Death by Age Group, United States – 2016

	Age Groups										
Rank	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	Total
1	Congenital Anomalies 4,816	Unintentional Injury 1,261	Unintentional Injury 787	Unintentional Injury 847	Unintentional Injury 13,895	Unintentional Injury 23,984	Unintentional Injury 20,975	Malignant Neoplasms 41,291	Malignant Neoplasms 116,364	Heart Disease 507,118	Heart Disease 635,260
2	Short Gestation 3,927	Congenital Anomalies 433	Malignant Neoplasms 449	Suicide 436	Suicide 5,723	Suicide 7,366	Malignant Neoplasms 10,903	Heart Disease 34,027	Heart Disease 78,610	Malignant Neoplasms 422,927	Malignant Neoplasms 598,038
3	SIDS 1,500	Malignant Neoplasms 377	Congenital Anomalies 203	Malignant Neoplasms 431	Homicide 5,172	Homicide 5,376	Heart Disease 10,477	Unintentional Injury 23,377	Unintentional Injury 21,860	Chronic Low. Respiratory Disease 131,002	Unintentional Injury 161,374
4	Maternal Pregnancy Comp. 1.402	Homicide 339	Homicide 139	Homicide 147	Malignant Neoplasms 1,431	Malignant Neoplasms 3,791	Suicide 7,030	Suicide 8,437	Chronic Low. Respiratory Disease 17.810	Cerebro-vascular 121,630	Chronic Low. Respiratory Disease 154.596
5	Unintentional Injury 1,219	Heart Disease 118	Heart Disease 77	Congenital Anomalies 146	Heart Disease 949	Heart Disease 3,445	Homicide 3,369	Liver Disease 8,364	Diabetes Mellitus 14,251	Alzheimer's Disease 114,883	Cerebro-vascular 142,142
6	Placenta Cord. Membranes 841	Influenza & Pneumonia 103	Chronic Low. Respiratory Disease 68	Heart Disease 111	Congenital Anomalies 388	Liver Disease 925	Liver Disease 2,851	Diabetes Mellitus 6,267	Liver Disease 13,448	Diabetes Mellitus 56,452	Alzheimer's Disease 116,103
7	Bacterial Sepsis 583	Septicemia 70	Influenza & Pneumonia 48	Chronic Low Respiratory Disease 75	Diabetes Mellitus 211	Diabetes Mellitus 792	Diabetes Mellitus 2,049	Cerebro-vascular 5,353	Cerebro-vascular 12,310	Unintentional Injury 53,141	Diabetes Mellitus 80,058
8	Respiratory Distress 488	Perinatal Period 60	Septicemia 40	Cerebro-vascular 50	Chronic Low Respiratory Disease 206	Cerebro-vascular 575	Cerebro-vascular 1,851	Chronic Low. Respiratory Disease 4.307	Suicide 7,759	Influenza & Pneumonia 42,479	Influenza & Pneumonia 51,537
9	Circulatory System Disease 460	Cerebro-vascular 55	Cerebro-vascular 38	Influenza & Pneumonia 39	Influenza & Pneumonia 189	HIV 546	HIV 971	Septicemia 2,472	Septicemia 5,941	Nephritis 41,095	Nephritis 50,046
10	Neonatal Hemorrhage 398	Chronic Low Respiratory Disease 51	Benign Neoplasms 31	Septicemia 31	Complicated Pregnancy 184	Complicated Pregnancy 472	Septicemia 897	Homicide 2,152	Nephritis 5,650	Septicemia 30,405	Suicide 44,965

Data Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

Centers for Disease Control and Prevention
National Center for Injury Prevention and Control

Actual Causes of Death

Cause of death	# (% of deaths) 1990		# (% of deaths) 2000	
Tobacco	400,000	(19%)	435,000	(18%)
Diet/inactivity	300,000	(15%)	400,000	(17%)
Alcohol	100,000	(5%)	85,000	(5%)
Micorbial agents	90,000	(4%)	75,000	(4%)
Toxic agents	60,000	(3%)	66,000	(3%)
Motor Vehicles	25,000	(1%)	43,000	(2%)
Firearms	35,000	(2%)	29,000	(1%)
Sexual Behavior	30,000	(1%)	20,000	(<1%)
Illegal drugs	20,000	(<1%)	17,000	(<1%)
Total	1,060,000	(50%)	1,060,000	(48%)

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% that Died in Next 5 Years, Adults, 40-64 Years of Age, NLMS (late 1970)

- By sex
  - Males 6.9%
  - Females 3.6%
- By race
  - Black 7.1%
  - White 4.9%
- By ethnicity
  - Non-hispanic 5.2%
  - Hispanic 4.2%
- By marital status
  - Not married 7.0%
  - Married 4.6%
- By education
  - < HS 6.9%
  - HS 4.4%
  - College 3.6%
- By Income
  - < $25K 6.0%
  - $25-$50K 3.4%
  - >$50K 2.7%

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Gompertz Equation

- 1825 British actuary Benjamin Gompertz
- "the number of living corresponding to ages increasing in arithmetical progression, decreased in geometrical progression."
- geometrical decrease in survival with age existed because of a geometric increase in the "force of mortality"

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- $M_a = ce^{ba}$
- M_a = mortality rate at age a
- a = age
- c = initial mortality rate
- b = Gompertz parameter – exponential rate of change in mortality with age

- Note that if $y=e^{bt}$
- Then ln(y) = bt
- And then $\ln(M_a) = \ln(c) + ba$
- Log mortality rates are linear in age

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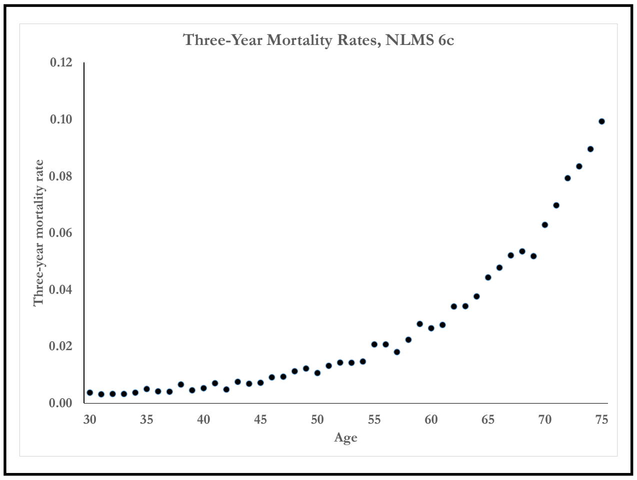
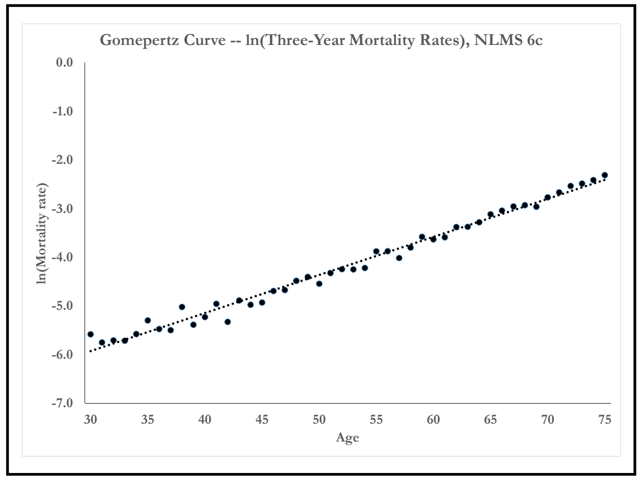
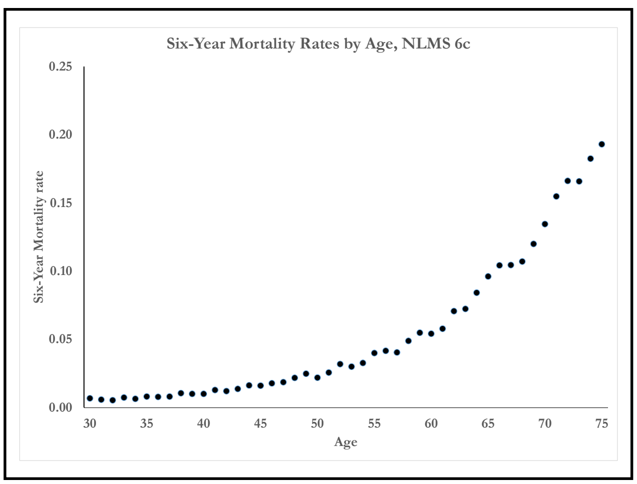
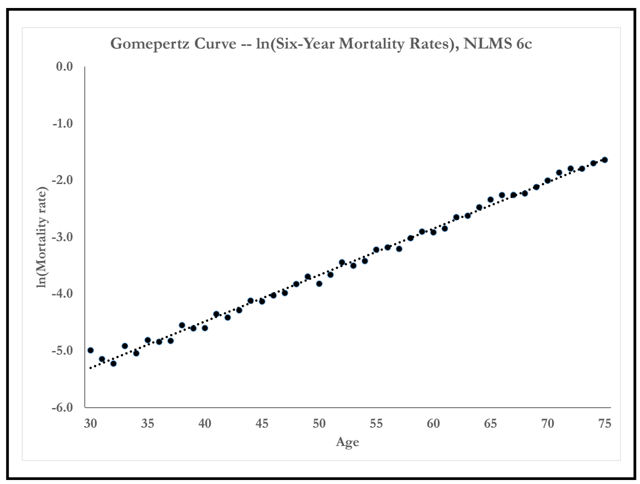

Three-Year Mortality Rates, NLMS 6c
Three-year mortality rate
0.12
0.10
0.08
0.06
0.04
0.02
0.00
30
35
40
45
50
55
60
65
70
75
Age


Gomepertz Curve -- ln(Three-Year Mortality Rates), NLMS 6c
ln(Mortality rate)
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
30
35
40
45
50
55
60
65
70
75
Age


Six-Year Mortality Rates by Age, NLMS 6c
Six-Year Mortality rate
0.25
0.20
0.15
0.10
0.05
0.00
30
35
40
45
50
55
60
65
70
75
Age


Gomepertz Curve -- ln(Six-Year Mortality Rates), NLMS 6c
ln(Mortality rate)
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
30
35
40
45
50
55
60
65
70
75
Age

```
. reg ln_diedin3 age

      Source |       SS       df       MS              Number of obs =      46
-------------+------------------------------           F(1, 44)      = 3032.19
       Model |  49.613138     1  49.613138           Prob > F      =  0.0000
    Residual |  .71993508    44 .016362161           R-squared     =  0.9857
-------------+------------------------------           Adj R-squared =  0.9854
       Total | 50.3330731    45 1.11851274           Root MSE      =  .12791

------------------------------------------------------------------------------
  ln_diedin3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0782267   .0014206    55.07   0.000     .0753636    .0810897
       _cons |  -8.273677     .07693  -107.55   0.000    -8.428719   -8.118634
------------------------------------------------------------------------------

. reg ln_diedin6 age

      Source |       SS       df       MS              Number of obs =      46
-------------+------------------------------           F(1, 44)      = 7572.87
       Model | 54.0343476     1 54.0343476           Prob > F      =  0.0000
    Residual | .313951225    44 .007135255           R-squared     =  0.9942
-------------+------------------------------           Adj R-squared =  0.9941
       Total | 54.3482988    45 1.20773997           Root MSE      =  .08447

------------------------------------------------------------------------------
  ln_diedin6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0816378   .0009381    87.02   0.000     .0797472    .0835285
       _cons |  -7.750209   .0508019  -152.56   0.000    -7.852594   -7.647825
------------------------------------------------------------------------------
```

- dln(M)/da = b
- dln(M) = dM/M = percentage change in M
- dln(M)/da = % change in M for a one year increase in age
- In the model above
  - ln(c)=-7.75
  - b=0.0816
- Mortality increases by 8.2% per year of age

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- b=(dM/M)/da,
- b(da) = dM/M
  - If a=10 years, mortality is predicted to increase 82% over 10 year period (same regardless of the starting age)
  - M = ce^{ba}
  - C=exp(-7.75) = 0.000495
- M = 0.00043e$^{0.081a}$
- Given a, one can predict the mortality rate for this group

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SES/Health Relationship

- Health (H) improves with Socioeconomic status (I)
- But at a decreasing rate
  - $dH/dI > 0$
  - $d^2H/dI^2 < 0$
- Relationship is true for
  - Nearly all measures of health
  - Nearly all measures of SES (income, wealth, education, status)
  - For all subgroups (by sex, race, age, etc)
  - For nearly all populations
  - For nearly all time period
  - For nearly all countries
- Focus on one measure of SES -- Income

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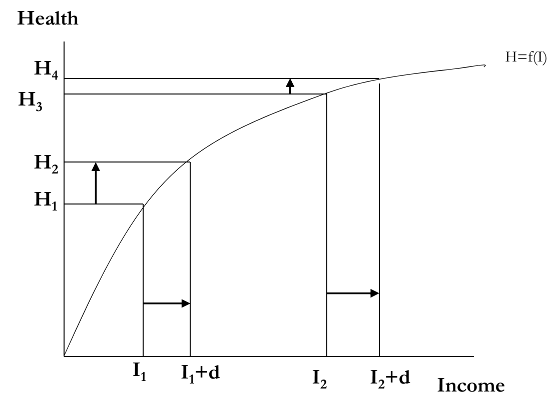

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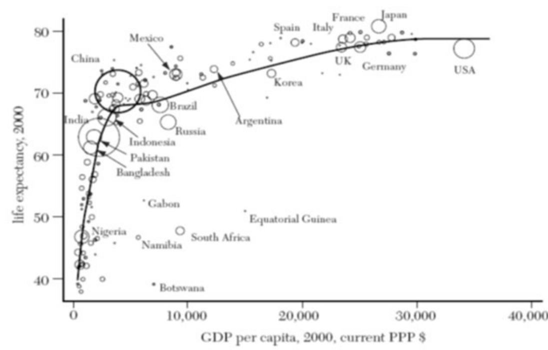

Figure 1. The Preston Curve: Life Expectancy versus GDP Per Capita

Chetty et al., JAMA 2014

- Match taxpayers (income) aged 40-76 from 1999-2014 to SS death records (mortality)
- 1.4 billion person records
- Income – pre-tax household earnings
  - If file taxes, get from 1040
  - If don't file taxes, get from W2/1099-G (Unemp. comp.)
  - If neither – assume income is zero

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Matching income to mortality

- Most people start to collect SS at age 63
- Earnings after this age not a good reflection of their SES status
- If under 63, earnings are the 2 years prior
- If 63 or over, earnings are at age 61
  - Data starts at age 40, years 1999-2014
  - Can follow a 61 year old for an additional 15 years – follow until people are 76

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Life expectancy

- Mortality is hard to think about as an outcome
- Expected life expectancy
- If die before age 76 – have actual outcome
- Use Gompertz curves to estimate expected mortality after age 76
- Translate expected mortality into expected lifespan

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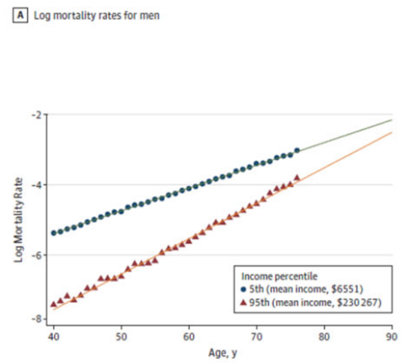

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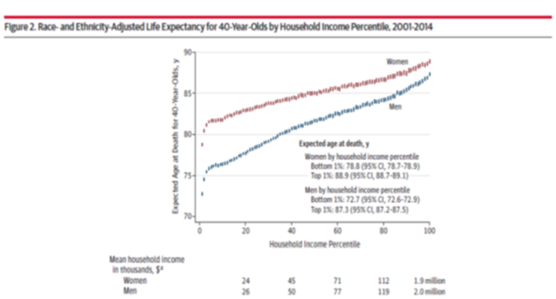

Difference in life expectancy between top and bottom 1%
Men: 87.3 – 72.7 = 14.6
Women: 88.9 – 78.8 = 10.1

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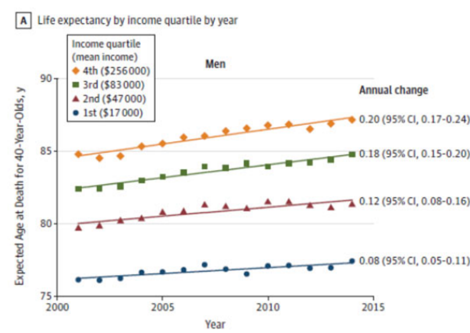
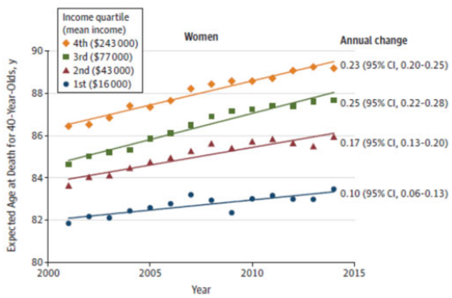
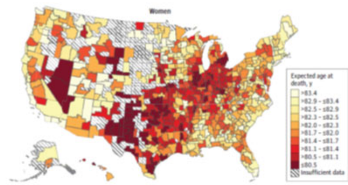


Difference between top and bottom quartile: 13 years growth. Growth rates are .2 and .08 per year. Difference is 13(.2-.08)=1.56 years

40

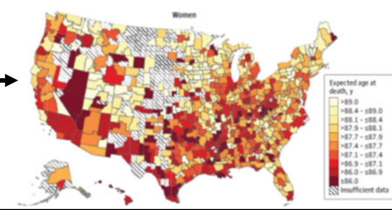


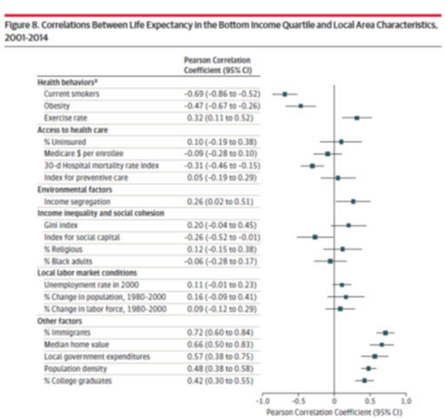
Difference between top and bottom quartile: 13 years growth. Growth rates are .23 and .10 per year. Difference is 13(.23-.10)=1.69 years



Bottom quartile

Top quartile





Health habits

Other measures of wealth

% Died in 6 Years, NLMS 6c

	Age groups		
Income	30-49	50-64	65-79
< High school	1.78	6.77	19.37
HS graduate	1.46	4.96	15.48
Some college	1.18	3.95	14.65
College	0.66	2.46	12.47

Percent Died within 5 years of Survey, Females NLMS

Education Group	35-54 years of age	55-64 years of age	65-74 years of age
Less than high school	2.0	6.0	11.7
High school graduate	1.3	4.3	9.7
College graduate	0.9	4.0	8.0

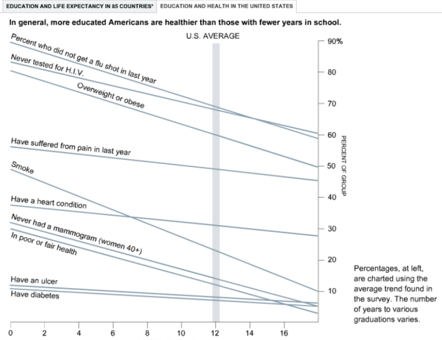
18-64 year olds, BRFSS 2005-2009 (% answering yes)

Educ Level	Fair or poor health	No exer. in past 30 days	Current smoker	Obese	Any bad mental hlth past 30 days
<12 Years	40.9	45.8	37.8	43.6	43.7
12-15 years	17.8	27.3	26.5	34.7	38.4
16+ Years	7.2	13.5	10.8	24.8	34.2

Sick and Can't Go to School? Or, Sick Because You Didn't Go?

What factors make certain groups of people live longer, healthier lives than others? In study after study, researchers around the world are consistently arriving at the same answer: education. New research indicates that the correlation actually does reflect a cause and effect.

EDUCATION AND LIFE EXPECTANCY IN 85 COUNTRIES* | EDUCATION AND HEALTH IN THE UNITED STATES



Sick and Can't Go to School? Or, Sick Because You Didn't Go?

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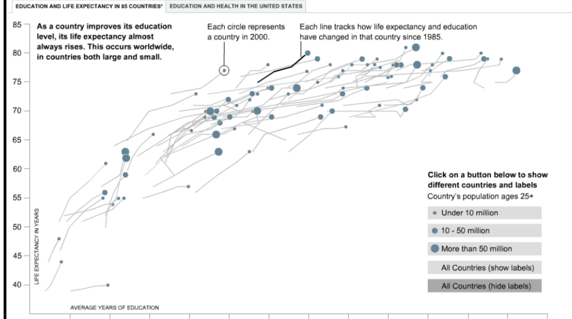
EDUCATION AND LIFE EXPECTANCY IN 85 COUNTRIES* | EDUCATION AND HEALTH IN THE UNITED STATES



*Countries with no data or large populations affected by H.I.V./AIDS were excluded.

Questions for class

- What are the possible mechanisms through which income (or education) can improve health?
- What data supports or refutes each of these hypotheses?
  - List possible explanations
  - Give some evidence for and against
  - Decide whether the pathway is a causal mechanism

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What do we mean by causal pathway?

- If causal, we assume that health is determined by income
  - For example, H=f(Income)
- Therefore, dH/dI>0
  - An exogenous change in income will alter health
- Example: Suppose we change social security benefits – if income is causal, this should alter mortality of the elderly

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Why is it hard to determine whether the income/health relationship is causal

- Many factors that determine high income
  - Drive/ambition/intelligence/risk taking/luck/background
- Many of these same factors can also impact health
- Therefore, we do not know whether income is causing better health, or some third factor that is unmeasured

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$$Died_i = \alpha + x_i\delta + income_i\beta + \varepsilon_i$$

$$Died_i = 1 \text{ if died within } 5 \text{ years}, = 0 \text{ otherwise}$$

$$x_i = controls$$

$$income_i = annual\ family\ income$$

$$\hat{\beta} \text{ unbiased is } E[\varepsilon_i \mid x_i, income_i] = 0$$

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Problem:

- Realization of ε_i conveys information about income
- If $\varepsilon_i>0$, more likely to die early
- Could mean you had lower income because you were sick and could not work as much (reverse causality)
- Could mean you have a hiogh discount rate – don't invest in human capital for the job market (which means lower income) and it means you maybe did not invest in health (which means higher ε_i)

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- Story we are telling is that cov(ε_i,income$_i$)<0
- We believe $\beta<0$
- This means we are "overstating" the impact of income on mortality –

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Table 3

Economic Effects of New Health Onset

	Wealth	*OOP Expenses*	*Total Medical Expenses*
HRS			
Mild onset	−3,620	635	2,555
Severe onset	−16,846	2,266	28,963
AHEAD			
Any onset	−10,481	1,026	NA
HRS severe onset only			
With health insurance	−17,417	1,912	26,957
Without health insurance	−17,282	4,576	42,166
HRS severe onset only			
Below median income	−11,348	2,439	29,829
Above median income	−25,371	2,014	28,085
AHEAD any onset			
Below median income	−4,427	915	NA
Above median income	−17,040	1,101	NA

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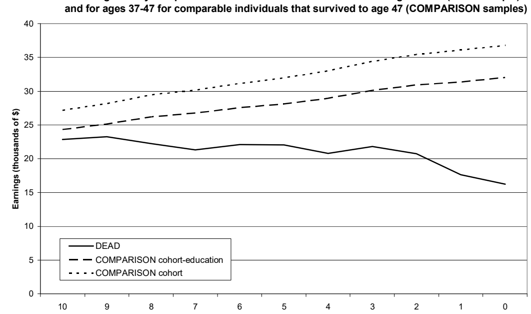
Earnings in 10 years prior to death for individuals that died while aged 45-49 (DEAD sample) and for ages 37-47 for comparable individuals that survived to age 47 (COMPARISON samples)



Note: the COMPARISON samples were constructed computing average annual earnings for ages 37 to 47, for individuals that survived up to age 47. In the COMPARISON cohort sample, individuals were weighted in order to match the distribution by cohort in the DEAD sample. In the COMPARISON cohort-education sample, individuals were weighted to match the distribution by cohort and education in the DEAD sample.

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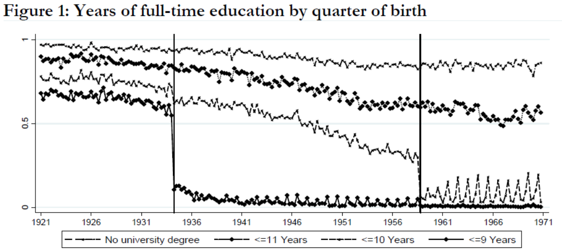
Clark and Royer

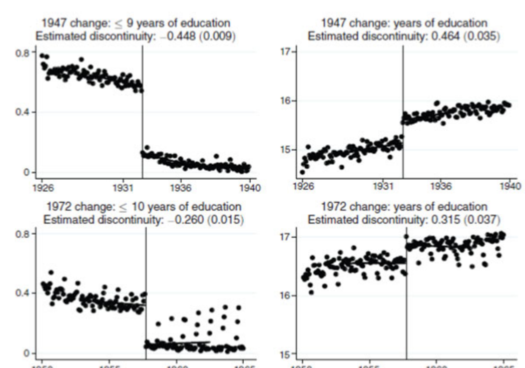
- Examines education/health link using shock to education in England
- 1944 law
  - Raised age of comp. schooling from 14-15
  - Went into effect April 1, 1947
  - Raised comp years of schooling to 9
  - Gave Minister of Ed power to increase to 16 under certain conditions
  - Did so in Sept 1, 1972
    - Raised comp. years of schooling to 10

- Produce large changes in education across birth cohorts
- Changes in education and health are "smooth" over birth cohorts
- If education alters health, should see a structural change in outcomes across cohorts as well
- What assumptions have to be true for this to generate an unbiased estimate of the impact of schooling on health?

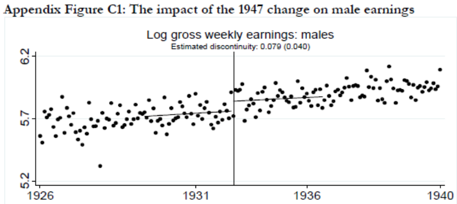
Figure 1: Years of full-time education by quarter of birth



Notes: Raw fractions are based on pooled waves (1991-2004) of the Health Survey of England. The vertical lines are cutoffs corresponding to the first cohorts subject to the new compulsory schooling laws. The first of these took effect on 1 April 1947, the second on 1 September 1957.



Appendix Figure C1: The impact of the 1947 change on male earnings



Notes: Scatter plot based on sample as described in notes to Appendix Table C1a. Fitted solid line based on birth cohort (defined by month of birth) interacte being born after April 1933. Estimated discontintuity refers to coefficient on this dummy variable; its standard error is presented in parentheses.

This figure is not in the paper but in a previous version.
It shows birth cohorts versus Ln(gross weekly earnings).
What does this graph show and why is this informative?

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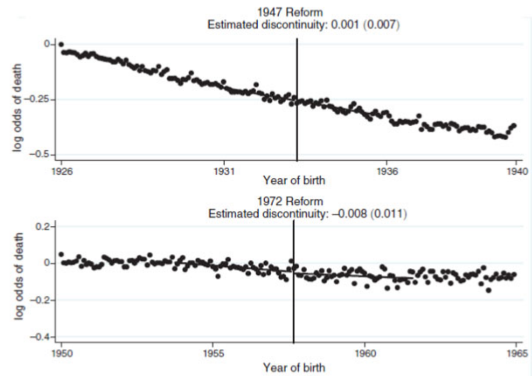

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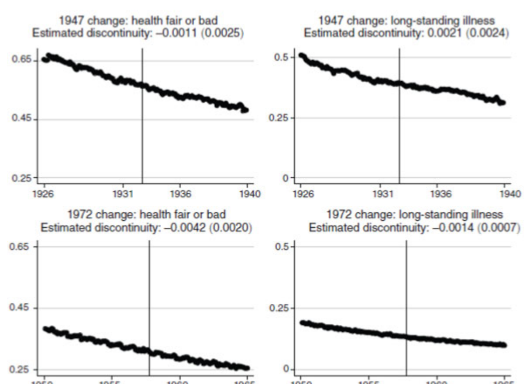

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Sullivan and von Wachter

- Consider the opposite of Gardner and Oswald – what happens when someone loses income
- Lost income due to job loss
- Focus on displacement?
  - What is displacement?
  - Why displacement and not job loss?

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Data

- 5% random sample of unemployment records in PA 1974-1991
- Have quarterly earnings
- Select sample of workers with the same employer 1974-1979 (firms > 50 workers)
- Identify people who have been "displaced"
  - Lose job 1980-1986
  - And when firm size falls by 30% or more

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Impact of displacement on earnings

$$y_{it} = \alpha_i + \lambda_t + x_{it}\beta + \sum_{k=-20}^{36} D_{it}^k \delta_k + \varepsilon_{it}$$

$i = person, \quad t = quarter$

$y_{it} = \ln(quarterly\ earnings)$

$\alpha_i = person\ effect$

$\lambda_t = quarter\ (time)\ effect$

$x_{it} = time - \text{var}\ ying\ characteristics$

$D_{it}^k = 1\ if\ \ person\ i\ was\ displaced\ k\ quarters\ ago(after)$

$\delta_k = effect\ of\ \ displacement$

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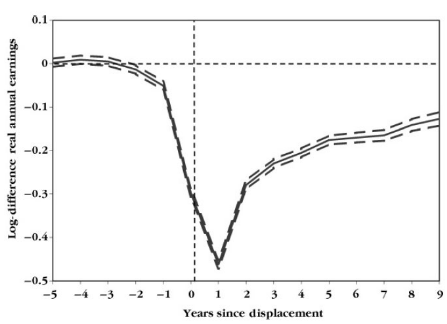

FIGURE I
Estimate of the Decline in Annual Earnings due to Job Displacement (Sample of Men in Stable Employment 1974–1979, Firm 1979 Employment ≥50, Born 1930–1959, Work in PA Labor Force Every Year 1980–1986)
Solid line represents coefficient estimates of the interaction of year effects and displacement dummies in a regression model of log quarterly earnings including year fixed effects, person fixed effects, and a quartic for age. Two standard error bands are drawn around main effects.

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Impact of displacement on mortality

$$y_{it} = \alpha_i + \lambda_t + x_{it}\beta + D_{it}\delta + \varepsilon_{it}$$

$i = person, \quad t = year$

$Sample: people\ alive\ 1/1/1980$

$y_{it} = 1\ if\ \ person\ dies\ in\ \ period\ t, = 0\ otherwise$

$D_{it} = 1\ if\ \ person\ i\ was\ displaced\ \text{in}\ the\ year$

$\delta_k = effect\ of\ \ displacement$

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TABLE I
(CONTINUED)

Work restriction in Pennsylvania labor market during 1980–1986	No work restriction			Work every year		
	All workers (1)	Displaced workers (2)	Nondisplaced workers (3)	All workers (4)	Displaced workers (5)	Nondisplaced workers (6)
Log(average quarterly earnings in 1987–1991)	8.606	8.184	8.791	8.728	8.421	8.838
	(1.069)	(1.310)	(0.883)	(0.891)	(1.064)	(0.792)
Log(std. dev. of log quarterly earnings in 1987–1991)	−1.344	−1.119	−1.440	−1.393	−1.197	−1.462
	(0.764)	(0.793)	(0.730)	(0.736)	(0.757)	(0.716)
Number of quarters in nonemployment in 1987–1991	4.31	6.66	3.11	2.20	3.32	1.79
	(7.070)	(8.207)	(6.079)	(4.736)	(5.900)	(4.145)
Deaths per 1,000 per year 1987–2006	6.764	7.639	6.325	6.343	6.913	6.132
	(0.143)	(0.263)	(0.170)	(0.152)	(0.306)	(0.175)
Deaths per 1,000 per year 1987–1993	4.167	5.151	3.670	3.745	4.400	3.502
	(0.181)	(0.347)	(0.208)	(0.189)	(0.393)	(0.214)
Deaths per 1,000 per year 1994–1999	7.407	8.114	7.053	6.994	7.451	6.826
	(0.227)	(0.411)	(0.272)	(0.242)	(0.481)	(0.280)
Deaths per 1,000 per year 2000–2006	10.815	11.909	10.270	10.347	11.033	10.094
	(0.427)	(0.777)	(0.510)	(0.458)	(0.911)	(0.529)

Notes. Standard deviations in parentheses (with exception for death rates, which show standard errors). The samples include only male workers born 1930–1959 in stable employment 1974–1979 at an employer of size fifty in 1979. Displaced workers left jobs in firms whose employment the subsequent year was 30% or more below its post-1974 peak. Information pertaining to employment and earnings is from Pennsylvania. Deaths can occur anywhere in the United States.

7.1/1000=0.007 mortality risk among non-displaced workers

TABLE II
EFFECT OF JOB DISPLACEMENT ON LOG-ODDS OF DEATH FOR VARIOUS SAMPLES, FOLLOW-UP PERIODS, AND SPECIFICATIONS (WORKERS IN STABLE EMPLOYMENT 1974–1979, FIRM 1979 EMPLOYMENT ≥50, BORN 1930–1959)

	No work restriction (1)	No work restriction (2)	Work at least three years (3)	Work every year (4)	Work every year, exclude non-MLF separators (JLS sample) (5)
Death follow-up period	1980–2006	1987–2006	1987–2006	1987–2006	1987–2006
(1) Baseline model with average and std. dev. of earnings in 1974–1979	0.170	0.147	0.148	0.088	0.104
	(0.036)	(0.037)	(0.038)	(0.044)	(0.046)
(2) Model in row (1) with one-digit industry fixed effects	0.170	0.137	0.139	0.077	0.098
	(0.037)	(0.038)	(0.039)	(0.045)	(0.047)
(3) Model in row (1) with one-digit industry effects and added career variables	0.163	0.129	0.128	0.069	0.088
	(0.038)	(0.039)	(0.040)	(0.047)	(0.048)
(4) Model in row (1) with industry effects and career variables*age interactions	0.169	0.136	0.138	0.077	0.098
	(0.037)	(0.038)	(0.039)	(0.045)	(0.047)
(5) Linear probability model (specification row (2))	0.0012	0.0011	0.0012	0.0006	0.0008
	(0.00026)	(0.00032)	(0.00031)	(0.00034)	(0.00034)
(6) Linear probability model (specification row (1)) with firm effects	0.0013	0.0008	0.0010	0.0006	0.0009
	(0.00038)	(0.00050)	(0.00048)	(0.00054)	(0.00051)

0.0012/0.007 = 0.17 = 17% increase in mortality risk

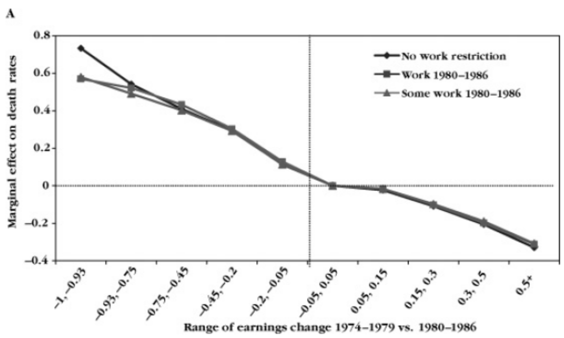
TABLE IV
MORTALITY IMPACT OF JOB DISPLACEMENT BY TIME SINCE DISPLACEMENT, AGE-GROUP, INDUSTRY, AND TENURE AT JOB LOSS FOR DIFFERENT SAMPLES (WORKERS IN STABLE EMPLOYMENT 1974–1979, FIRM 1979 EMPLOYMENT ≥50, NO FURTHER PRESENCE RESTRICTION IN PA LABOR MARKET)

Restriction on job tenure	Tenure in 1979 at least six years			Tenure in 1979 at least three years		
Birth cohort	1930–1959 (1)	1920–1959 (2)	1920–1959 (3)	1930–1959 (4)	1920–1959 (5)	1920–1959 (6)
Displacement effect 16+ years after displacement	0.131	0.108	0.133	0.161	0.123	0.152
	(0.054)	(0.034)	(0.055)	(0.05)	(0.032)	(0.05)
Added effect for 1 year after displacement year	0.716	0.619	0.582	0.782	0.606	0.585
	(0.199)	(0.105)	(0.113)	(0.176)	(0.099)	(0.106)
Added effect for 2–3 years after displacement year	0.559	0.307	0.279	0.525	0.318	0.303
	(0.147)	(0.084)	(0.091)	(0.136)	(0.078)	(0.084)
Added effect for 4–5 years after displacement year	0.198	0.040	0.020	0.204	0.033	0.024
	(0.147)	(0.082)	(0.086)	(0.135)	(0.077)	(0.081)
Added effect for 6–10 years after displacement year	0.057	0.045	0.036	0.027	0.053	0.051
	(0.094)	(0.054)	(0.057)	(0.087)	(0.051)	(0.053)
Added effect for 11–15 years after displacement year	−0.066	−0.045	−0.046	−0.053	−0.044	−0.042
	(0.081)	(0.047)	(0.048)	(0.073)	(0.044)	(0.045)
Displacement and current age less than or equal to 45			0.383			0.220
			(0.131)			(0.116)
Displacement and current age between 46 and 55			0.136			0.117
			(0.075)			(0.066)

TABLE III
COEFFICIENTS ON CAREER VARIABLES IN EXTENDED LOG-ODDS OF DEATH MODEL (VARIOUS SAMPLES, WORKERS IN STABLE EMPLOYMENT 1974–1979, FIRM 1979 EMPLOYMENT ≥50, BORN 1930–1959)

Work restriction in Pennsylvania labor market during 1980–1986	No work restriction (1)	No work restriction (2)	Work at least three years (3)	Work every year (4)	Work every year, exclude non-MLF separators (JLS sample) (5)
Death follow-up period	1980–2006	1987–2006	1987–2006	1987–2006	1987–2006
Displacement dummy	0.163	0.129	0.128	0.069	0.069
	(0.038)	(0.040)	(0.040)	(0.047)	(0.047)
Log(average quarterly earnings 1974–1979)	−0.504	−0.516	−0.499	−0.472	−0.472
	(0.055)	(0.057)	(0.058)	(0.066)	(0.066)
Log(std. dev. of log quarterly earnings 1974–1979)	0.172	0.163	0.170	0.174	0.174
	(0.027)	(0.028)	(0.028)	(0.032)	(0.032)
Number of quarters in nonemployment 1974–1979	−0.090	−0.090	−0.087	−0.095	−0.095
	(0.025)	(0.026)	(0.026)	(0.031)	(0.031)
Growth in quarterly earnings 1974–1979	−0.002	0.008	0.016	0.015	0.015
	(0.052)	(0.054)	(0.055)	(0.062)	(0.062)
1-digit dummies for 1979 industry	Yes	Yes	Yes	Yes	Yes
Observations	505,316	367,890	358,660	308,345	308,345

Notes. These are coefficients on covariates included in model (3) of Table II. Please refer to notes to Table II for further explanations. Standard errors are in parentheses.



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Stress as an explanation for the SES/Health Gradient

- Usual suspects don't explain gradient
- Leading candidate is Stress
- Low SES face more persistent stress
- Body reacts to stress in a good way in the short run
- Persistent stress can cause more permanent damage

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HPA Axis

- Hypothalamic-pituitary-adrenal axis
- Put into work when the body faces stress
- Regulates many body functions including digestion, immune, mood, emotions, energy storage
- Concern: activation of system is "good" under stress, but it does come at a cost. Therefore, persistent stress generates more permanent damage to the body's systems

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Cortisol

- Circadian rhythm. Rises when awake, in late afternoon
- Regulates many activites
- Under stress, more cortisol is produced
  - Increases availability of glucose
  - Suppresses energy available to other systems like immune
  - Cortisol reduces after the stress subsides
- Problems
  - constant stress leads to dysregulation of HPA
  - Stress in early life can generate dysfunction of HPA

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Cortisol

- Stress increases cortisol
  - Higher among residents
  - Higher among accountants near April 15th
- Poor have elevated cortisol at all times
  - They are more exposed to stress
- Elevated cortisol thought to
  - "burn out" major organs – they just work harder
  - Increases susceptibility of immune system

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Primate research

- Observational studies show worse health among subordinate male baboons
  - Elevated stress hormone (glucocorticoid) levels, worse cholesterol profile
- Experimental manipulation of status provides more compelling evidence
  - Causal effects of subordination and harmful effects of "status competition"

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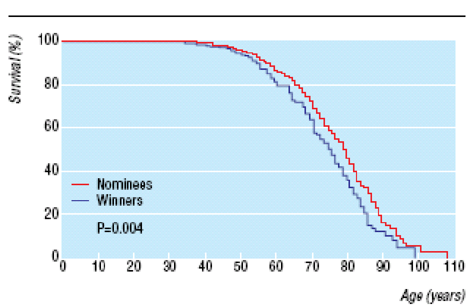

Survival of winners and nominees of academy awards for screenwriting. The graph shows the percentage of each group alive, plotted by using the Kaplan-Meier technique. Primary statistical analysis is based on a log rank test comparing winners to nominees (n=185, deaths=112 and n=610, deaths=316, respectively)

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Baseball Hall of Fame

- Baseball Writers Association of America
  - Annual voting held since 1936
  - Eligibility: >10 seasons in MLB, retired 5+ years, max of 15 ballot appearances
  - Voting: ~ 450 voters, mail-in ballot, can name up to 10 players
  - Induction: Must be named on 75% of total ballots cast
  - Compete voting results are reported to public (newspapers)
- Committee on Baseball Veterans (Veterans)
  - Select former MLB players not chosen by BBWAA
  - Historically voting was held annually
  - Much smaller committee (~15), but similar 75% required for induction
  - Voting results not publicly disclosed and accusations of cronyism
  - Major reforms in 2001 (expanded voting pool, public disclosure)

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Sample

- All players alive while appearing on at least one ballot between 1945-2006
- Restrict analysis to pre-1946 births to reduce censoring (N=597)
- Key derived variables:
  - Indicators of induction status (BBWAA and veterans)
  - Maximum vote share ever received (categorical: <1, 1-2, …, 51-74, 75-78…)
  - Number of "close losses" (defined as vote share ≥ 50 but <75)

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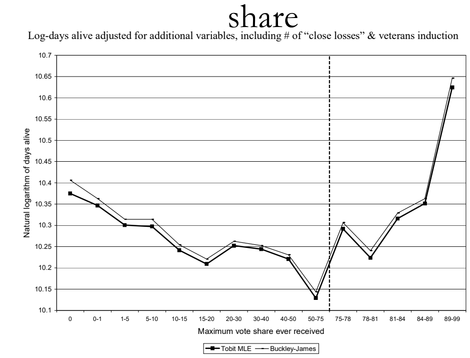
Adjusted life duration by maximum vote share



Notes: See notes to Figure 4. Analysis also adjusts for total number of nominations, a quadratic in birthday, and a college attendance indicator.

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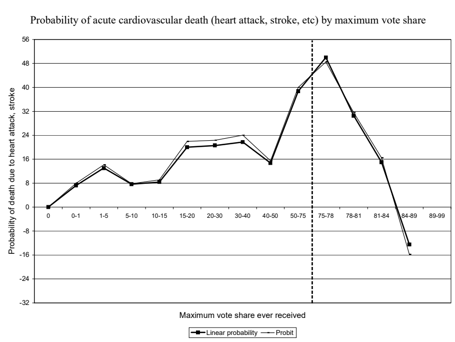
Cause of death by maximum vote share



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