Health and Economic Growth

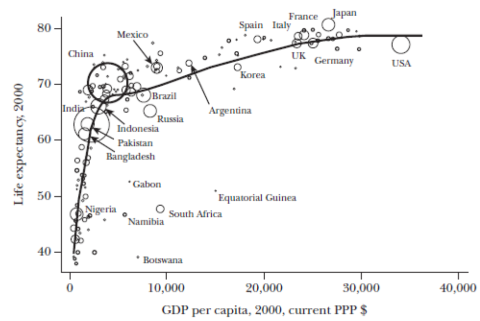
Health Economics

Bill Evans

Fall 2020

Figure 1

The Preston Curve: Life Expectancy versus GDP Per Capita



Preston Curve

- Suggestive of a causal link – greater economic success increases life expectancy
- Could also suggest health is key to development – economies grow with a healthy population
- Belief by many that poor health is holding back the development of many countries – especially in Africa

Many interesting questions

- Role of rising incomes?
- What do those rising incomes purchase that allows mortality to fall?
- Can you "jump start" the change in mortality?
- Q we are going to consider is a little different – does health detract from growth and can a healthier population improve economic returns?
  – Some suggestive evidence from previous section

Case study: Malaria

- Burden
  - 300-500 million cases per year
  - 1 -3 million fatalities, mostly children
  - 90% of malaria mortality in Africa
- Centered on tropics
  - Transmission less likely when temp <18^{o}C (64.4)
  - Parasite dies at 16^{o}C (60.8)
- Has been successfully eradicated in the US

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Figure 1 Global distribution of malaria. The changing global distribution of malaria risk from 1946 to1994 shows a disease burden that is increasingly being confined to tropical regions.

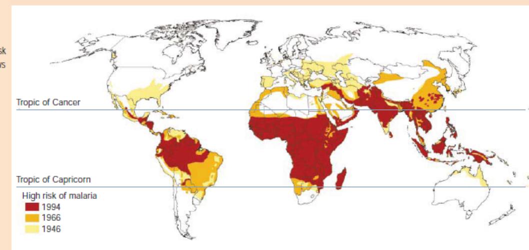

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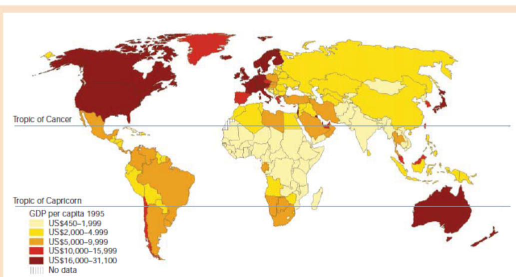
Figure 2 Global distribution of per capita GDP. The global pattern of income distribution is highly uneven, with average income levels significantly lower in tropical regions.



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Jeff Sachs

- *"…malaria not only takes an enormous human toll in Africa, but also contributes to an enormous economic loss and is a barrier to economic growth. Investments in malaria control thus offer an enormous return in lives saved and in economic benefits for Africa."*

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What we do in this lecture

- Isolate pathways through which health can impact growth. Provide:
  - Theoretical link
  - Empirical evidence for each of these links
  - Emphasis on historical data
- Some examples – rapid changes in mortality – does it impact health?

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Bloom and Canning

4 pathways linking health to growth

1. Productivity
2. Education
3. Investments in Physical Capital
4. Demographic dividend

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Health and productivity

- Many good papers demonstrate a link between heath shocks and
  - Contemporaneous productivity
  - Productivity later in life
- Much from developing country
- One quick example from the US -- 1918 Flu epidemic

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1918 Flu Epidemic

- Spanish flu
- World wide epidemic
  - Killed 30-50 million, 675K in the US
- Those particularly vulnerable
  - Children
  - Compromised immune system
  - Pregnant women

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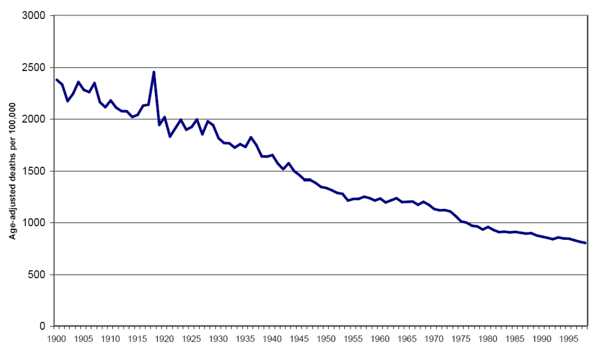
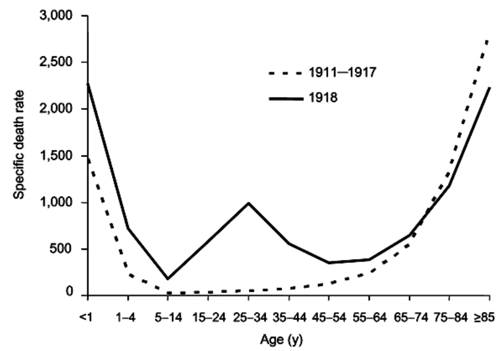
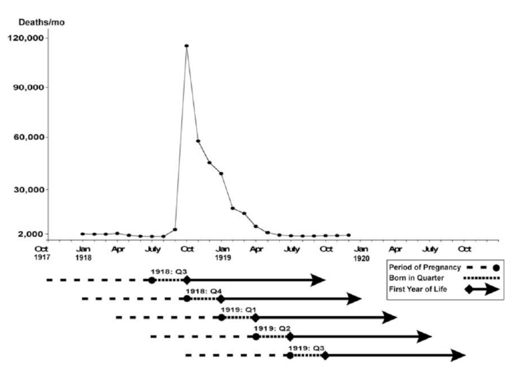
Fig. 1: All cause mortality[a]



a - Death rates shown are adjusted to standard population of U.S. in 1940





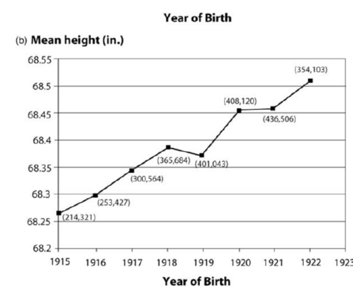
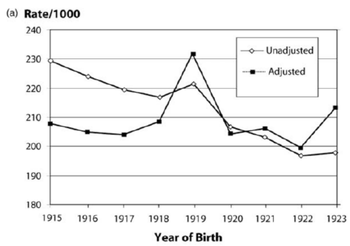


Fig. 2.
Cardiovascular disease (1982–1996) and mean height (1941–1942) by birth year: (*a*) National Health Interview Surveys (NHIS) of 1982–1996 (USA), shown as unadjusted, or adjusted for cohort trend and year for sample aged 60 to 82 years. (*b*) Male height at ages 19 to 27 years, by birth year at enlistment in 1941 and 1942; from the National Archives and Records Administration (numbers of registrants in parenthesis).



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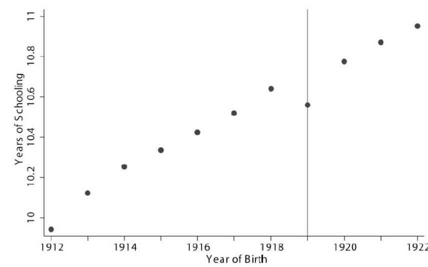

FIG. 3.—1960 average years of schooling: men and women born in the United States

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Bloom and Canning

4 pathways linking health to growth

1. Productivity
2. Education
3. Investments in Physical Capital
4. Demographic dividend

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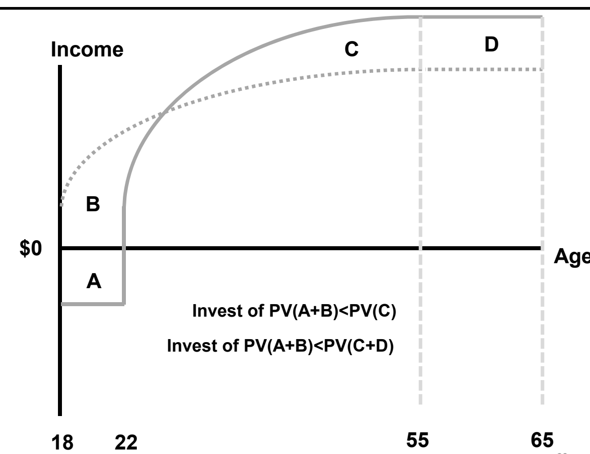

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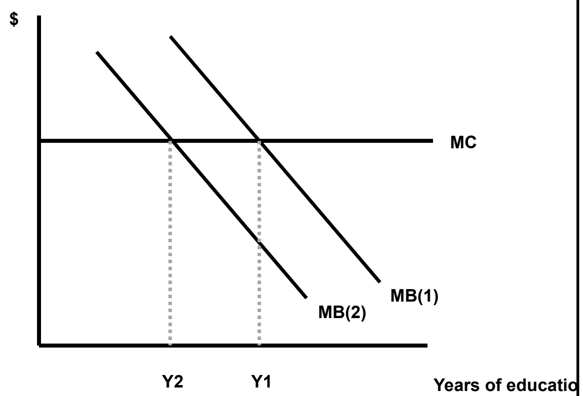


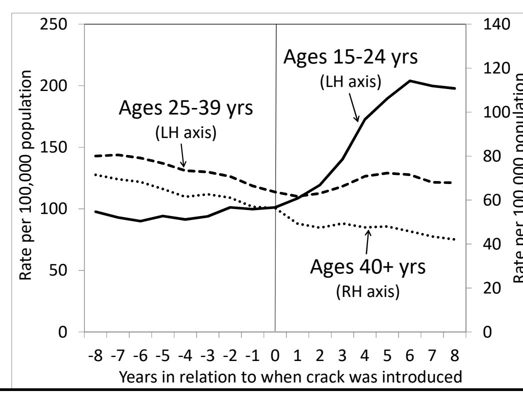
Evidence: Rise of Crack Cocaine

- Crack enters in 1982 on coasts – spreads to the center of the country
- Devastating to young black males
  - 2x ↑ murder rate
  - 4x ↑ in incarceration rates
- Human capital models – should see↓ investment
  - ↓ life expectancy
  - ↓ job prospects (due to prison records)
  - ↑ "outside" option

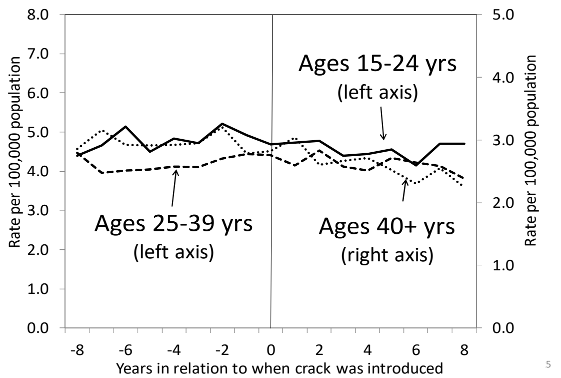
When Crack Arrives

- 1982: NY, LA, Miami
- 1983: Atlanta, Riverside, SF
- 1984: Seattle, Tampa, San Jose, Ft. Lauderdale
- 1985: Detroit, Houston, KC, Orange Co., Philly, DC
- 1986: Boston, Chicago, Cleveland, Indy, Memphis, MSP, New Orleans, Newark, Sacramento
- 1987: Dallas, Portland, Milwaukee, Hartford, Newark, Providence, Greensboro/WS

Murder rates black males 57 cities



Murder rates white females 57 cities



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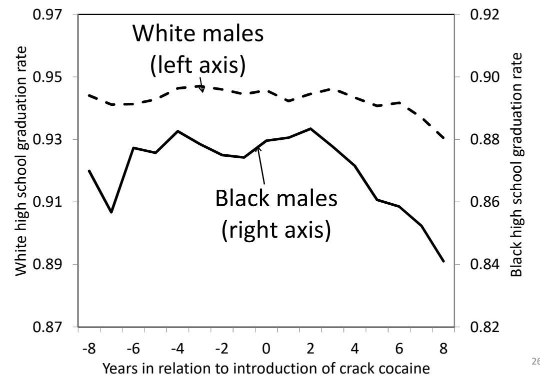
HS grad. Rates in Males, 57 MSAs



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Are there other situations where there are rapid changes in mortality that one can use in the same manor?

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Bloom and Canning

4 pathways linking health to growth

1. Productivity
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Bloom and Canning

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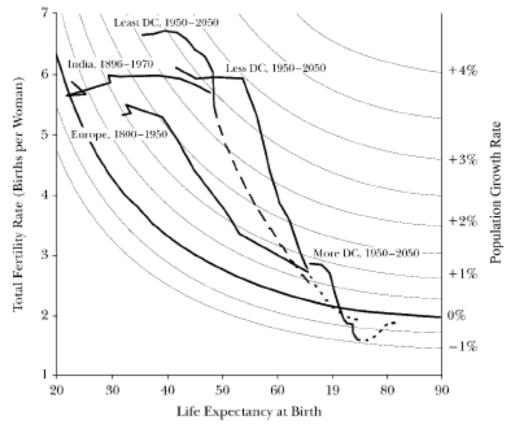


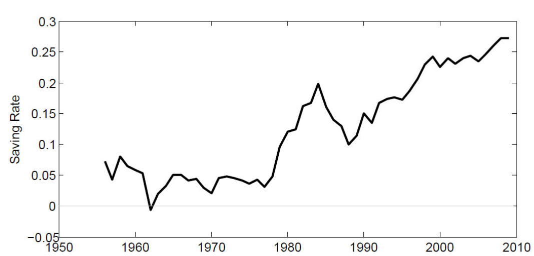
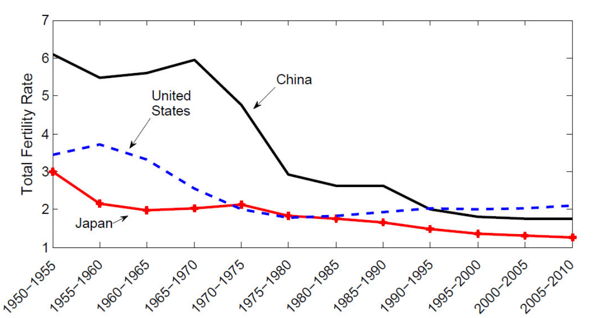


Figure 1: Saving as a share of household income, 1955-2009. Source: Modigliani and Cao (2004) and the *China Statistical Yearbook* (various issues).



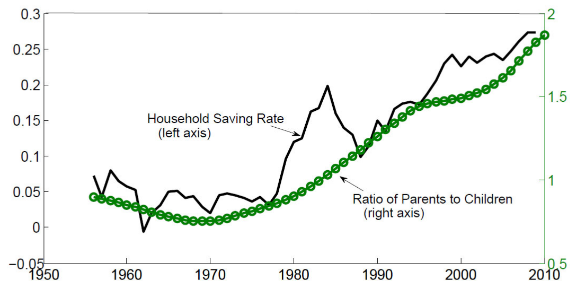


Figure 3: Household saving rate (left axis) and ratio of parents, age 20-50, to children, age 0-19 (right axis)

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Alternate hypothesis: Black Plague

- Plague strikes Europe 1348-1350
- Carried by flees living on black rats
- Shipping routes spread the disease quickly
- Kills 75 – 200 million
- Reduces pre-plague population in England by 50%

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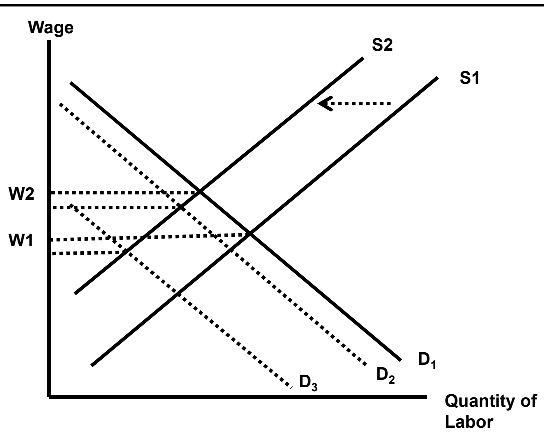

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Table 1. *Population of selected European countries, 1300–1800 (in thousands)*

	1300	1400	1500	1600	1700	1800
England and Wales	5,750	3,000	3,500	4,450	5,450	9,250
Netherlands	800	600	950	1,500	1,950	2,100
Belgium	1,250	1,000	1,400	1,600	2,000	2,900
Italy	12,500	8,000	9,000	13,300	13,500	18,100
Spain	5,500	4,500	5,000	6,800	7,400	11,000
Total Europe	94,200	67,950	82,950	107,350	114,950	192,230

Source: Paolo Malanima (unpublished manuscript).

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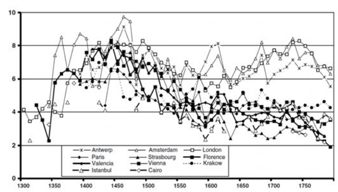

Figure 2. *Real wages of unskilled workers, 1300–1800*

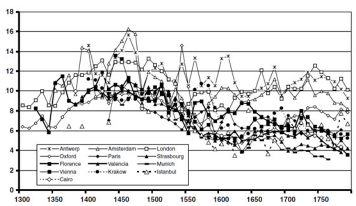

Figure 3. *Real wages of skilled workers, 1300–1800*

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Consequences

- Europe in 1300s was mired in stagnant wages and high population
- Massive decline in population increased value of labor
- Jump-started income growth in Europe
- Young: "Gift of Dying." Argues the same for Africa and AIDS

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Acemoglu and Johnson (JPE)

- International epidemiological transition
  - Began in 1940
  - Large improvements world wide in life expectancy
- Three factors
  - Drugs (mass production of penicillin, antibiotics), vaccines (polio, measles, etc.), DDT
  - WHO
  - Change in universal values – encouraged spread of changes to poor countries

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- IDT was "technology" based
- Therefore – it impacted poor countries the most (impacted those most in need)
- Exogenous change in mortality
- Since it impacted poor countries the most, we should see a greater change in GDP for this group if health has an impact on the economy

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LIFE EXPECTANCY AND ECONOMIC GROWTH 927

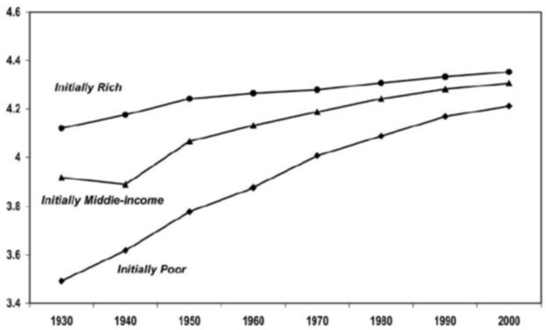

FIG. 1.—Log life expectancy at birth for initially rich, middle-income, and poor countries in the base sample.

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LIFE EXPECTANCY AND ECONOMIC GROWTH 929

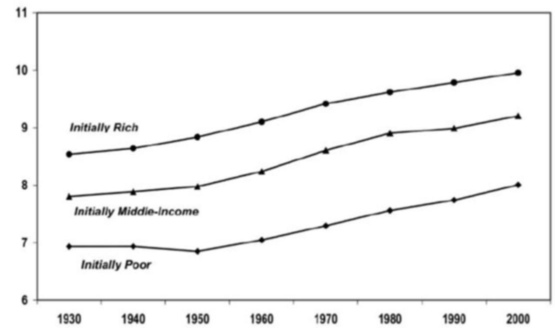

FIG. 2.—Log GDP per capita for initially rich, middle-income, and poor countries in the base sample.

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Explaining results

- Drop in mortality increases population
- Should increase output
- BUT -- because capital is fixed
  - Capital used more intensely
  - Productivity declines, reduces wages
- Growth in output from more people is not enough to compensate for loss in productivity per worker
- Black plague argument

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TABLE 2
LIFE EXPECTANCY, POPULATION, BIRTHS, AND PERCENTAGE OF POPULATION UNDER 20: OLS ESTIMATES

	WHOLE WORLD (1)	BASE SAMPLE (2)	BASE SAMPLE (3)	LOW- AND MIDDLE-INCOME COUNTRIES ONLY (4)	BASE SAMPLE (5)	LOW- AND MIDDLE-INCOME COUNTRIES ONLY (6)
	A. Dependent Variable: Log Population					
	Just 1960 and 2000	Just 1960 and 2000	Just 1940 and 1980	Just 1940 and 1980	Just 1940 and 2000	Just 1940 and 2000
Log life expectancy	1.60	1.75	1.62	1.86	2.01	2.25
	(.30)	(.40)	(.19)	(.26)	(.22)	(.32)
Number of countries	120	59	47	36	47	36

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TABLE 3
Life Expectancy, GDP, GDP per Capita, and GDP per Working Age Population: OLS Estimates

	Whole World: Just 1960 and 2000 (1)	Base Sample: Just 1960 and 2000 (2)	Base Sample: Just 1940 and 1980 (3)	Low- and Middle-Income Countries Only: Just 1940 and 1980 (4)	Base Sample: Just 1940 and 2000 (5)	Low- and Middle-Income Countries Only: Just 1940 and 2000 (6)
A. Dependent Variable: Log GDP						
Log life expectancy	1.17	1.55	.78	.65	.85	.43
	(.56)	(.35)	(.33)	(.42)	(.28)	(.38)
Number of countries	120	59	47	36	47	36
B. Dependent Variable: Log GDP per Capita						
Log life expectancy	−.42	−.19	−.81	−1.17	−1.14	−1.79
	(.58)	(.54)	(.26)	(.38)	(.27)	(.41)
Number of countries	120	59	47	36	47	36

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Bleakley – Hookworm Removal in South

- Intestinal parasite, absorbs nutrients
- Symptoms: lethargy and anemia
- Death is rare
- Hookworm eventually dies, but re-infection high
- Two ways to reduce harm
  - Treatment (cheap de-worming medicine)
  - Prevention (reduced exposure to fecal matter)

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Rockefeller Sanitation Commission

- Formed in 1910
- Goal – eradicate hookworm in the US
- Dr. Charles Stiles convinced Rockefeller of the problem
- Surveyed 600 counties in south
- Found 40% hookworm infection rate among kids

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Campaign

- Primary period was 1910-15
- Treated over 400K with de-worming medicine
- Educated doctors to recognize disease
- Public education about prevention
- Program eventually taken over by state/local governments

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Questions

- Did campaign reduce hookworm incidence?
- Did campaign improve educational outcomes?

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Research Strategy

- Hookworm infection rates differ across areas
- Areas with high infection rates should benefit more from the campaign
- Basic difference-in-difference model
  - Low infection rate areas – treated
  - High infection rates are control
- Sound familiar?

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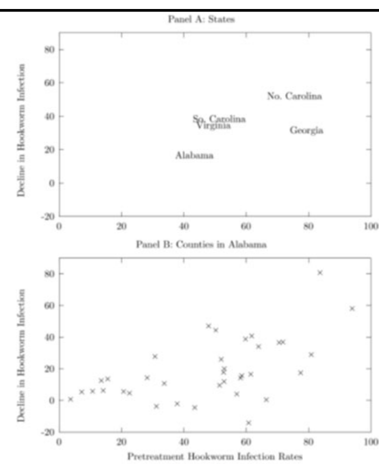

FIGURE I

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Econometric model

$$Y_{ijt} = (H_j^{pre} x Post_j)\beta + \delta_t + \gamma_j + X_{ijt}\Gamma + \varepsilon_{ijt}$$

person i, *area* j, *time* t

Y_{ijt} *outcome* (*like enrolled in school*)

$Post_j = 1$ *after* 1915

H_j^{pre} = *hookwork incidence rate before* 1910

δ_t *and* γ_j *are time and area effects*

X_{ijt} *are control variables*

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Comtemporaneous outcomes for kids

TABLE II
HOOKWORM AND HUMAN CAPITAL: BASIC RESULTS

Dependent variables:		(1) School enrollment	(2) Full-time school attendance	(3) Literacy
		Panel A: Basic results		
Census years	*Estimating equation*			
(A) 1910–1920	(1)	0.0883***	0.1591***	0.0587***
		(0.0225)	(0.0252)	(0.0186)
(B) 1900–1950	(1)	0.0608***	0.1247***	
		(0.0261)	(0.0286)	
(C) 1900–1950	(2)	0.0954***	0.1471***	
		(0.0233)	(0.0287)	

A high pre-intervention infection rate is 50%. 0.5 * 0.0883 = 0.04 – an increase
In school enrollment rates of 4 percentage points.

Falsification test

- Hookworms are thought to alter outcomes for children
- Suppose we look at adults over the same time period
- Should they be impacted by the intervention?

TABLE IV
CONTEMPORANEOUS EFFECT ON ADULT OUTCOMES

Samples:	(1) Whole	(2) Male	(3) Female	(4) White	(5) Black
	Parameter estimates				
Dependent variables:					
Literacy	0.0062	−0.0107	0.0203	0.0107	−0.0014
	(0.0095)	(0.0108)	(0.0127)	(0.0112)	(0.0229)
Labor-force participation	−0.0069	−0.0069	−0.0056	−0.0212	0.0036
	(0.0134)	(0.0065)	(0.0284)	(0.0124)	(0.0249)
Occupational income score	0.0526	−0.0186	0.0581	0.0855	0.0224
	(0.2836)	(0.4912)	(0.4163)	(0.3903)	(0.3861)
Lives in an urban area	0.0157	0.0030	0.0280	0.0199	0.0132
	(0.0172)	(0.0190)	(0.0177)	(0.0226)	(0.0245)

Each cell reports the coefficient estimate on Hookworm × Post for the indicated sample and dependent variable. Robust standard errors in parentheses (clustering on SEA times post, number of clusters = 230). None of the reported coefficients is statistically significant at conventional confidence intervals. The sample consists of all native-born white and black adults in the 1910–1920 IPUMS between the ages of 25 and 55 (inclusive) in the RSC-surveyed geographic units. Reporting of additional coefficient estimates is suppressed. Specifications also include dummy variables for SEA, age, black, female, and year, as well as interactions of the demographic variables with $Post_t$.

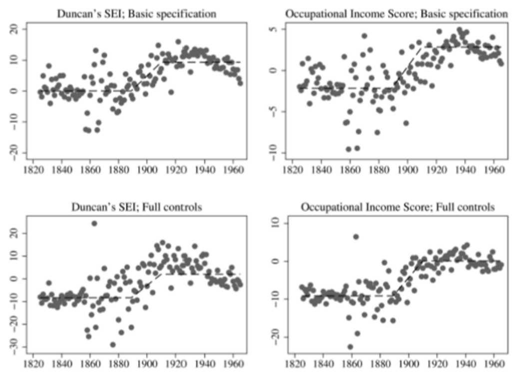
TABLE V
LONG-TERM FOLLOWUP BASED ON INTENSITY OF EXPOSURE TO THE TREATMENT CAMPAIGN

	(1)	(2)	(3)	(4)	(5)	(6)
Controls for mean-reversion:	No	Yes	No	Yes	No	Yes
Dependent variables:	Log earnings, 1939		Years of schooling, 1940		Literacy status, 1920	
	Panel A: Main results					
Independent variables						
Hookworm infection Rate × years of exposure	0.0286***	0.0234**	−0.0243	0.0037	0.0158***	0.0115***
	(0.0066)	(0.0093)	(0.0328)	(0.0357)	(0.0019)	(0.0020)
	Panel B: Changing returns to schooling					
Independent variables						
Hookworm infection Rate ×	0.0254***	0.0219***				
Years of exposure	(0.0044)	(0.0063)	n.a.		n.a.	
Infection × Years of exposure ×	0.0023***	0.0022**				
Years of schooling	(0.0009)	(0.0009)				

First row, first column:

50% infection rate, 10 years of exposure

0.50(10)(0.029) = 0.145 or a 14.5% increase in earnings



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Why the disparity in results?

- Bleakley shows convincing evidence of growth in outcomes later in life given medical advances in early life
- Similar results from 1918 Flu
- What is different about Acemoglu and Johnson?

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Cutler et al., Malaria Eradication in India

- Will reductions in Malaria necessarily lead to higher education?
- What are definitive predictions about outcomes?
  - Income/consumption
  - education?

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Malaria Eradication in India

- National Malaria Control Program launched April of 1953
- Heavy use of DDT
  - Effective, nontoxic for humans, cheap
  - Eradicated malaria in Taiwan, Caribbean, Balkans, parts of North Africa, north Australia, large parts of South Pacific
- Prior to program, 75 million annual cases in India and 800K annual deaths (~350 million people)

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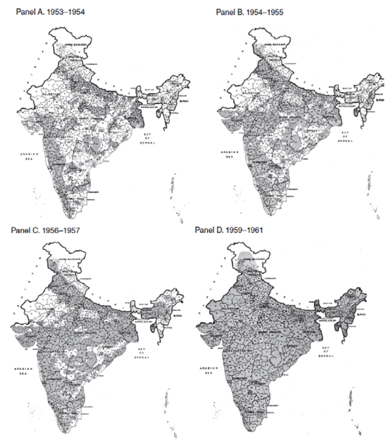
- Two annual rounds of spraying
  - 1/3 of country initially part of program
  - Program reformulated in 1958
  - Whole country part of program in 1960-61
- Strategy – Difference-in-Difference
  - Compare outcomes of groups – some born before and after eradication program
  - Variation in timing of program across regions
  - Some areas had higher pre-treatment malaria rates so allow treatment to vary



Model

$$y_{icd} = x_{icd}\gamma + POST_c x Malaria_d \beta + \delta_d + \alpha_c + \varepsilon_{icd}$$

$i = person,\ c = cohort,\ d = district$

$y = outcome$

$x = \mathrm{cov}\, ariates$

$POST_c = 1\ if\ \ cohort\ was\ born\ after\ eradication\ program$

$Malaria_d = malaria\ incidence\ rate\ prior\ to\ program$

$\alpha_d = district\ effects$

$\delta_c = cohort\ effects$

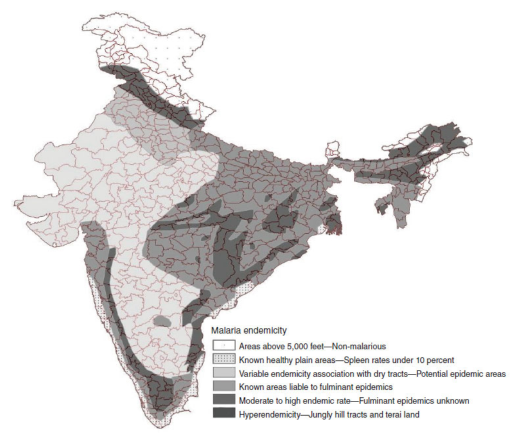


Figure 2. Malaria Endemicity Map

TABLE 2—CHILDHOOD MALARIA EXPOSURE AND HUMAN CAPITAL ATTAINMENT

	Literacy (ages 15–75)				Primary school (ages 15–75)			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A2. Districts classified by average malaria category								
Post × malaria index	−0.017	0.004	−0.001	0.008	−0.016	0.002	−0.005	0.009
	(0.006)***	(0.005)	(0.006)	(0.011)	(0.007)**	(0.006)	(0.008)	(0.010)
Observations	111,139	111,139	111,139	111,139	111,139	111,139	111,139	111,139
State × post fixed effects		X				X		
Region × post fixed effects			X	X			X	X
District-specific linear trends				X				X
B2. Districts classified by average malaria category								
Post × malaria index	0.005	0.011	−0.006	0.008	−0.004	0.005	−0.012	0.002
	(0.006)	(0.006)*	(0.006)	(0.010)	(0.007)	(0.006)	(0.008)	(0.007)
Observations	107,472	107,472	107,472	107,472	107,472	107,472	107,472	107,472
State × post fixed effects		X				X		
Region × post fixed effects			X	X			X	X
District-specific linear trends				X				X

A includes results for males, B for females

TABLE 3—CHILDHOOD MALARIA EXPOSURE AND ADULT ECONOMIC STATUS

	Log per capita household expenditure (ages 20–60)			
Dependent variable:	(1)	(2)	(3)	(4)
A2. Districts classified by average malaria category				
Post × malaria index	0.008	0.011	0.019	0.008
	(0.004)**	(0.005)**	(0.006)***	(0.011)
Observations	75,230	75,230	75,230	75,230
State × post fixed effects		X		
Region×post fixed effects			X	X
District-specific linear trends				X
B2. Districts classified by average malaria category				
Post × malaria index	−0.003	−0.003	0.004	0.011
	(0.004)	(0.004)	(0.005)	(0.014)
Observations	75,212	75,212	75,212	75,212
State × post fixed effects		X		
Region × post fixed effects			X	X
District-specific linear trends				X

A includes results for males, B for females