Health and Economic Growth

Econ 43565
Bill Evans
Fall 2018

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

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.”
What we do in this lecture

- Isolate pathways through which health can impact growth. Provide:
  - Theoretical link
  - Empirical evidence
- Consider some special cases (malaria and AIDS)
  - High incidence diseases and serious consequences
  - Have these diseases hindered growth?

Bloom and Canning

4 pathways linking health to growth
1. Productivity
2. Education
3. Investments in Physical Capital
4. Demographic dividend

Health and productivity

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

![Graph showing mortality rates](image-url)
Bloom and Canning

4 pathways linking health to growth
1. Productivity
2. Education
3. Investments in Physical Capital
4. Demographic dividend
Evidence: Rise of Crack Cocaine

- Crack enters in 1982 on coasts – spreads to the center of the country
- Devastating to young black males
  - $2x \uparrow$ murder rate
  - $4x \uparrow$ in incarceration rates
- Human capital models – should see $\downarrow$ investment
  - $\downarrow$ life expectancy
  - $\downarrow$ job prospects (due to prison records)
  - $\uparrow$ “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
Are there other situations where there are rapid changes in mortality that one can use in the same manner?
<table>
<thead>
<tr>
<th>Age</th>
<th>2009</th>
<th>2013</th>
<th>2009</th>
<th>2013</th>
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<td>White non-Hispanic, high school or less</td>
<td>1,087.6</td>
<td>1,422.8</td>
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<tr>
<td>White non-Hispanic, high school or less</td>
<td>2,390.0</td>
<td>2,693.6</td>
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<td>335.2</td>
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<td>2,171.4</td>
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</tbody>
</table>

- White 25-29: 82% increase
- Black 25-29: 8% decline
- White 30-34: 90% increase
- Black 30-34: 12.5% decline

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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
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 0-10.
Alternate story: 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%
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

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°C (64.4)
  – Parasite dies at 16°C (60.8)
• Has been successfully eradicated in the US
• “...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 improved, and in economic benefits for Africa.”

• [Health...] is a key precondition to economic development. The burden of disease in some low-income regions, especially in sub-Saharan Africa, is a major challenge to economic growth. Health must therefore be addressed directly in any comprehensive development strategy.

How malaria impacts the pathways in Bloom and Canning

• Education
  − Lost school days (11% of primary school days lost in Kenya to malaria alone)
  − 13-50% of lost school days in Kenya
  − Malaria impacts nutrition and brain development
  − Malaria can impact fetal development

• Physical capital
  − Health shocks reduce savings by decreasing work
  − Increase out of pocket spending

Economic impact

• $Y_{it} = \text{Annual GDP growth rate in 5-year period}$
• $M_{it} = \text{Malaria morbidity rate (cases/100,000)}$
• $X_{it} = \text{other covariates}$
• $t=1983-88, 1988-93, 1993-98$
Consider cross sectional regression

\[ Y_{it} = \beta_0 + X_{it}\beta_1 + M_{it}\beta_2 + \epsilon_{it} \]

Would \( \beta_2 \) be unbiased?

Consider pooled cross sectional/time series regression

\[ Y_{it} = \beta_0 + X_{it}\beta_1 + M_{it}\beta_2 + u_i + v_t + \epsilon_{it} \]

\( u_i \) is a country fixed effect
\( v_t \) is a year fixed effect

Would \( \beta_2 \) be unbiased?

Coefficient (standard error) on \( \beta_2 \) in the pooled regression is -0.000062 (0.000028)

Malaria incidence rates

- Medium ~ 600 (median for world)
- High ~ 10000 (75th percentile for Africa)
- \( \Delta M = -9400 \) (if go from medium high Malaria country)

\[ \Delta Y/\Delta M = -0.000062 \]
\[ \Delta Y = \beta_2(\Delta M) = -0.000062(-9400) = -0.58 \]

Is this a big number?

Assume per capita GDP is $2000
- current day Nigeria

At 3%/year growth, grows to $3507 in 20 years

At 2.5% growth, grows to $3197, which is 8% less
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)

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

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

Questions

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

Econometric model

\[ Y_{ji} = (H_{ji}^{pre} x \text{Post}_j) \beta + \delta_j + \gamma_j + X_{ij} \Gamma + \epsilon_{ij} \]

- person \( i \), area \( j \), time \( t \)
- \( Y_{ji} \) outcome (like enrolled in school)
- \( \text{Post}_j = 1 \) after 1915
- \( H_{ji}^{pre} = \) hookwork incidence rate before 1910
- \( \delta_j \) and \( \gamma_j \) are time and area effects
- \( X_{ij} \) are control variables

Contemporaneous outcomes for kids

<table>
<thead>
<tr>
<th>Table II</th>
<th>HOOPWORM AND HUMAN CAPITAL: BASIC RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variables:</td>
<td>School enrollment</td>
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<tr>
<td></td>
<td>(1)</td>
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<tr>
<td>Census years</td>
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<tr>
<td>(A) 1910–1920</td>
<td>0.0883***</td>
</tr>
<tr>
<td></td>
<td>(0.0225)</td>
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<tr>
<td>(B) 1900–1950</td>
<td>0.0608***</td>
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<td>(0.0251)</td>
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<tr>
<td>(C) 1900–1950</td>
<td>0.0594***</td>
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<tr>
<td></td>
<td>(0.0233)</td>
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</tbody>
</table>

A high pre-intervention infection rate is 50%. 0.5 * 0.0883 = 0.04 – an increase in school enrollment rate 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?

57% infection rate, 10 years of exposure

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

Table IV

<table>
<thead>
<tr>
<th>Samples:</th>
<th>(1) Whole</th>
<th>(2) Male</th>
<th>(3) Female</th>
<th>(4) White</th>
<th>(5) Black</th>
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</thead>
<tbody>
<tr>
<td>Parameter estimates</td>
<td></td>
<td></td>
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<tr>
<td>Dependent variables:</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Literacy</td>
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<td>0.0203</td>
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<td>(0.0086)</td>
<td>(0.0108)</td>
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<td>(0.0229)</td>
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<tr>
<td>Labor force</td>
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<td>-0.0069</td>
<td>-0.0056</td>
<td>-0.0212</td>
<td>0.0036</td>
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<tr>
<td>(0.0014)</td>
<td>(0.0008)</td>
<td>(0.0264)</td>
<td>(0.0172)</td>
<td>(0.0248)</td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>0.0086</td>
<td>0.0086</td>
<td>0.0086</td>
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<td>(0.0071)</td>
<td>(0.0071)</td>
<td>(0.0071)</td>
<td>(0.0071)</td>
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<tr>
<td>Occupational income</td>
<td>0.0326</td>
<td>-0.0188</td>
<td>0.0581</td>
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<td>0.0224</td>
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<td>(0.0268)</td>
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<td>Lives in an urban area</td>
<td>0.0157</td>
<td>0.0059</td>
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<td>(0.0172)</td>
<td>(0.0190)</td>
<td>(0.0177)</td>
<td>(0.0286)</td>
<td>(0.0245)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Each cell reports the coefficient estimate on Hookworms × Post for the indicated sample and dependent variable. Robust standard errors in parentheses (clustering on HED districts), length of exposure varies by sample, and mean number of clusters = 205. The dependent variables are literacy (mean years of schooling, years of schooling, and years of schooling), labor force, and participation. All regressions include district and year fixed effects, as well as an interaction between the intervention (Post) and all income indicators (only income indicators for black). Stata's `xtreg` command is used for panel regressions, with district and year fixed effects, as well as an interaction between the intervention (Post) and all income indicators (only income indicators for black). Stata's `xtreg` command is used for panel regressions, with district and year fixed effects, as well as an interaction between the intervention (Post) and all income indicators (only income indicators for black).
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?

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)

• 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

\[ y_{icd} = x_{icd} \gamma + \text{POST}_i \times \text{Malaria}_d \beta + \delta_c + \alpha_d + e_{icd} \]

\( i = \text{person}, c = \text{cohort}, d = \text{district} \)
\( y = \text{outcome} \)
\( x = \text{covariates} \)
\( \text{POST}_i = 1 \text{ if cohort was born after eradication program} \)
\( \text{Malaria}_d = \text{malaria incidence rate prior to program} \)
\( \alpha_d = \text{district effects} \)
\( \delta_c = \text{cohort effects} \)

### Table 2: Childhood Malaria Exposure and Human Capital Attainment

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Primary school (ages 6–7)</th>
<th>Literacy (ages 6–7)</th>
<th>Primary school (ages 15–16)</th>
<th>Literacy (ages 15–16)</th>
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</thead>
<tbody>
<tr>
<td>A1. Districts classified by average malaria category</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<td>Post x malaria index</td>
<td>0.003***</td>
<td>0.002***</td>
<td>0.002***</td>
<td>0.002***</td>
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<tr>
<td>Post x post fixed effects</td>
<td>0.003***</td>
<td>0.002***</td>
<td>0.002***</td>
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<tr>
<td>Region x post fixed effects</td>
<td>0.003***</td>
<td>0.002***</td>
<td>0.002***</td>
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<tr>
<td>Distinct-specific linear trends</td>
<td>0.003***</td>
<td>0.002***</td>
<td>0.002***</td>
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<tr>
<td>Observations</td>
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<td>75,212</td>
<td>75,212</td>
<td>75,212</td>
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<tr>
<td>A2. Districts classified by average malaria category</td>
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<tr>
<td>Post x malaria index</td>
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<td>75,212</td>
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</tbody>
</table>

A includes results for males, B for females
AIDS in Sub Saharan Africa

- 12% of world’s population but 67% of world’s AIDS cases
- Approximately 40 million cases worldwide in 2006
- Greatly reduced life expectancy


- Swaziland (26.0%)
- Lesotho (23.3%)
- South Africa (17.3%)
- Zimbabwe (14.9%)
- Namibia (13.4%)
- Mozambique (11.3%)
- Malawi (10.0%)
- Uganda (7.2%)
Acemoglu and Johnson (JPE)

- International epidemiological transition
  - Began in 1940
  - Large improvements worldwide 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

- 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
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

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td>LIFE EXPECTANCY, POPULATION, BIRTHS, AND PERCENTAGE OF POPULATION UNDER 20: OLS ESTIMATES</td>
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<tr>
<td>Log life expectancy</td>
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<td>Number of countries</td>
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<table>
<thead>
<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td>LIFE EXPECTANCY, GDP, GDP PER CAPITA, AND GDP PER WORKING AGE POPULATION: OLS ESTIMATES</td>
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<td>Log life expectancy</td>
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<td>Number of countries</td>
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</table>

A. Dependent Variable: Log GDP

B. Dependent Variable: Log GDP per Capita