# Lecture 13: Health II: Disease and Development: Micro and Macro Approaches

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14.73 Challenges of World Poverty

# Disease and Development

- Incidence of life-threatening ('high mortality') and debilitating ('high morbidity') diseases is much higher in developing countries
- These diseases obviously affect quality of life (shorter life expectancy for you and your family/friends, more suffering while alive)
- But do these diseases also matter for *economic* living standards?
- Why would we expect them to matter (or not)?

# This Lecture

We discuss 2 papers in this area:Bleakley (2007): 'Malaria Eradication in the Americas: A Retrospective Analysis of Childhood Exposure'

1. 
   - 'Micro' approach
   - Finds large effects
   - Method: difference in differences
2. Acemoglu and Johnson (2007): 'Disease and Development: The Effect of Life Expectancy on Economic Growth'
   - 'Macro' approach
   - Finds no effect (on output per capita)
   - Method: instrumental variables

# Bleakley (2007)

# Malaria

- Malaria persists in tropical regions up to the present day
- Big question: Does malaria hold back economic progress? Sachs: yes, big time.
- Narrower (but still important!) question in this paper: Does childhood exposure to malaria inhibit learning and subsequent labor productivity.
- Why would we expect an effect?

# Childhood malaria $\Rightarrow$ Learning, Wages?

- This is a hard question to answer.
- Why is it hard to answer?
- How would you try to answer it?

# How does this paper try to answer it?

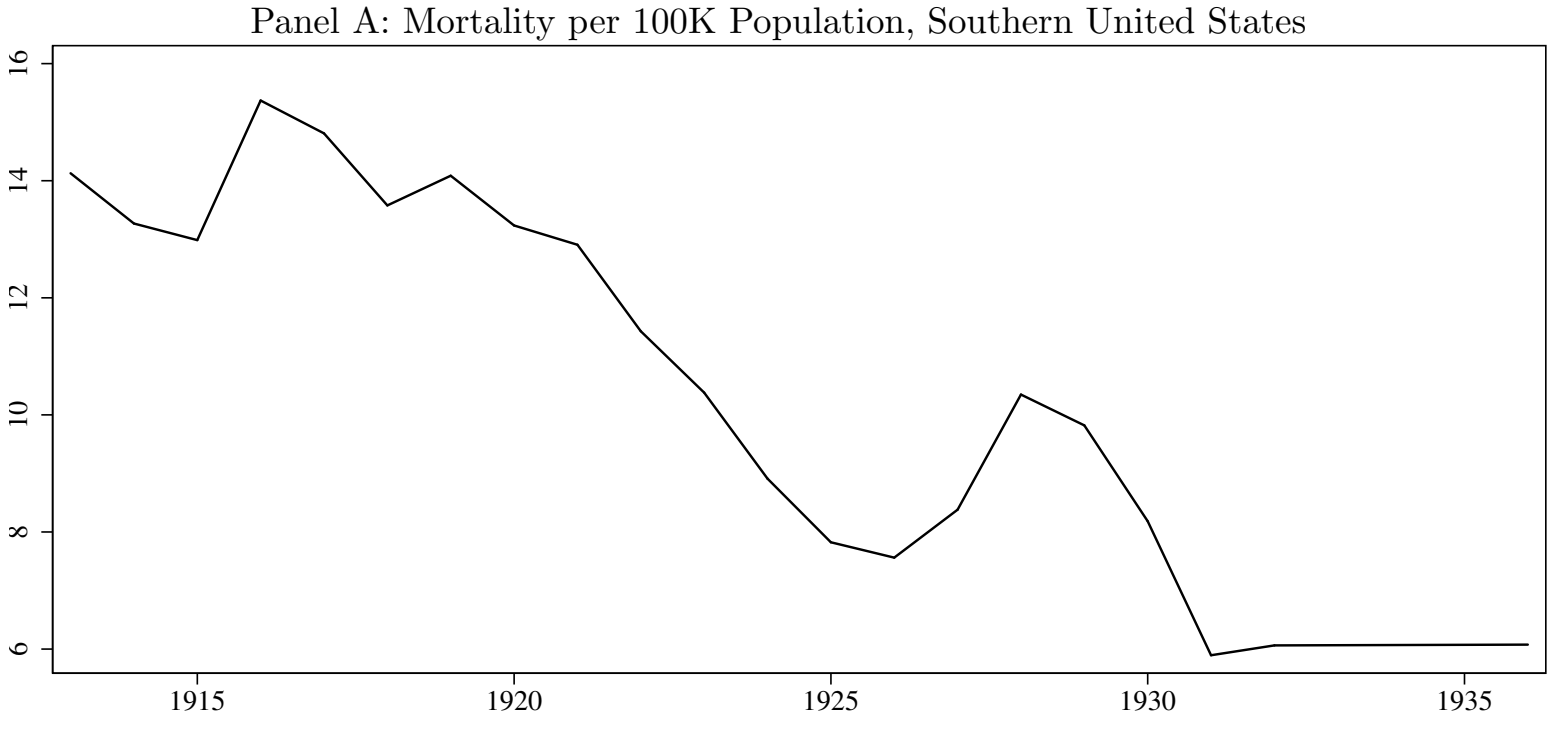
- Examine large malaria eradication program in Americas (US South, Brazil, Colombia, Mexico)
- Eradication was suddenly possible for 'exogenous' reasons
- Compare people born before the eradication to people born after it $\longrightarrow$ *first difference*
- Further compare across regions of counties in which pre-eradication malaria was high and low $\longrightarrow$ *second difference*
- 'Difference-in-differences'

# Recall: Difference-in-differences

- Consider eradication in US South; suppose it happened overnight in 1920.
- Take data on wages of adults in 1970: $Y$
- First difference: compare adults born before (eg born 1902) to those born after (eg born 1921): $Y_{1921} - Y_{1902}$
  - Why not just stop here?
- Second difference: do the first comparison again across adults from two regions, with high and eradication intensity: $[Y^H_{1921} - Y^H_{1902}] - [Y^L_{1921} - Y^L_{1902}]$
  - Why not just use $Y^H_{1902} - Y^L_{1902}$?
- Our DID estimate of the effect of childhood malaria eradication on wages is: $[Y^H_{1921} - Y^H_{1902}] - [Y^L_{1921} - Y^L_{1902}]$
- What could be wrong with this logic?

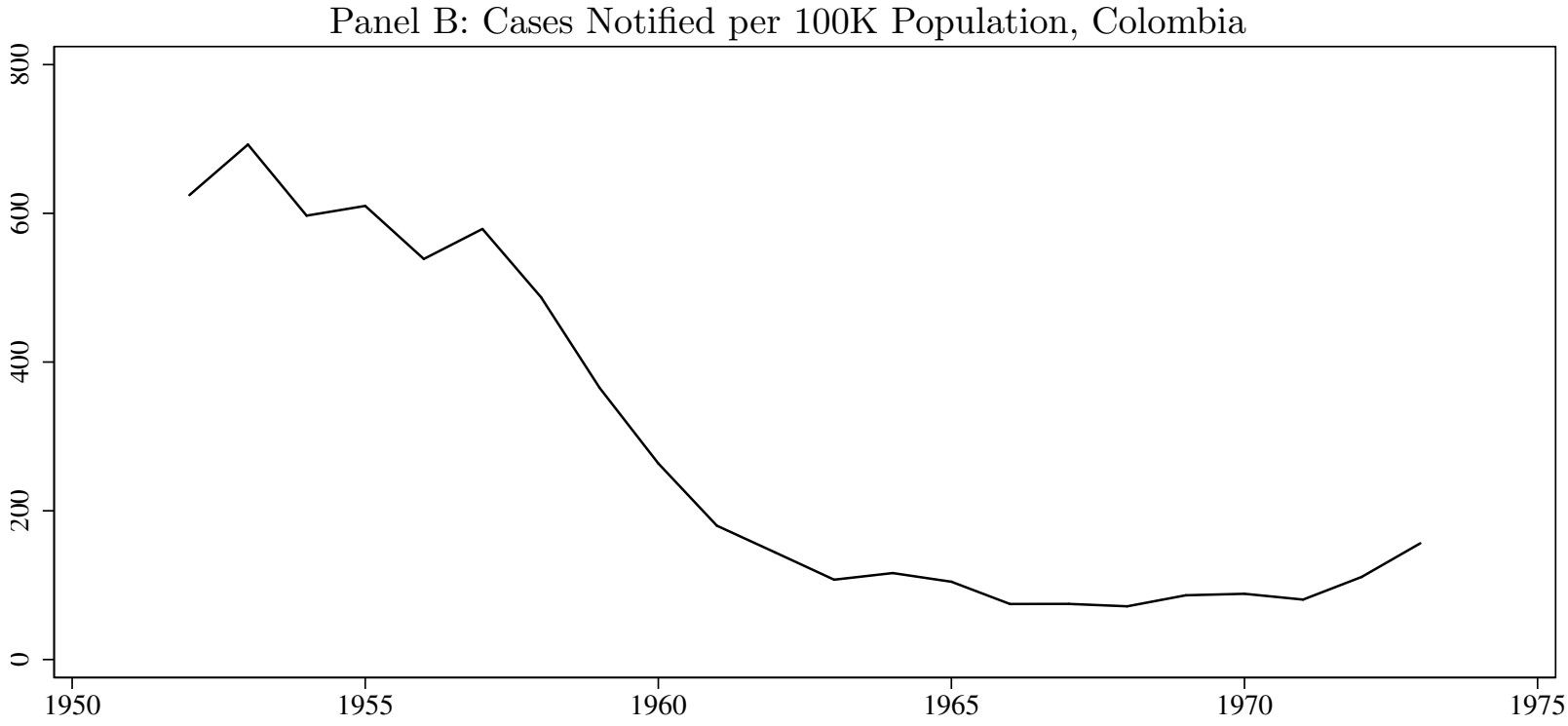
# The Eradication Programs

- US South: 1920s, after successful programs (and fundamental knowledge
  of how malaria spreads) in military areas of Havana and Panama



# The Eradication Programs

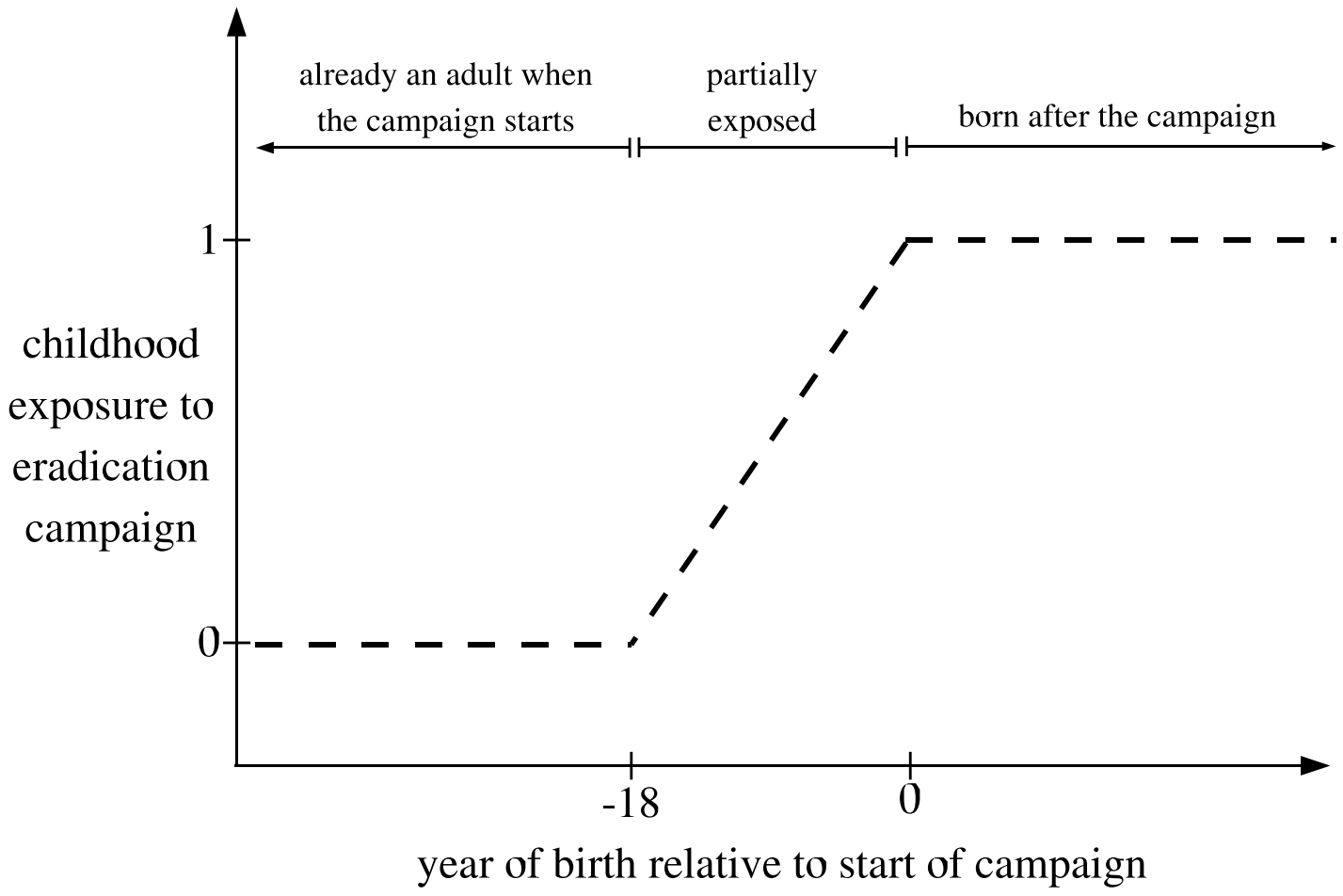
- Brazil, Colombia, Mexico: 1950s, discovery of pesticide, DDT.



# First Difference: Time Variation

- Imagine eradication occurred overnight in 1950 in Brazil.
- You have data on Brazilians of all ages in, say, 1980.
- Who among these people got lots of childhood exposure to malaria?
- Who got no exposure to malaria?
- Who got intermediate amounts of exposure?

# First Difference: Time Variation



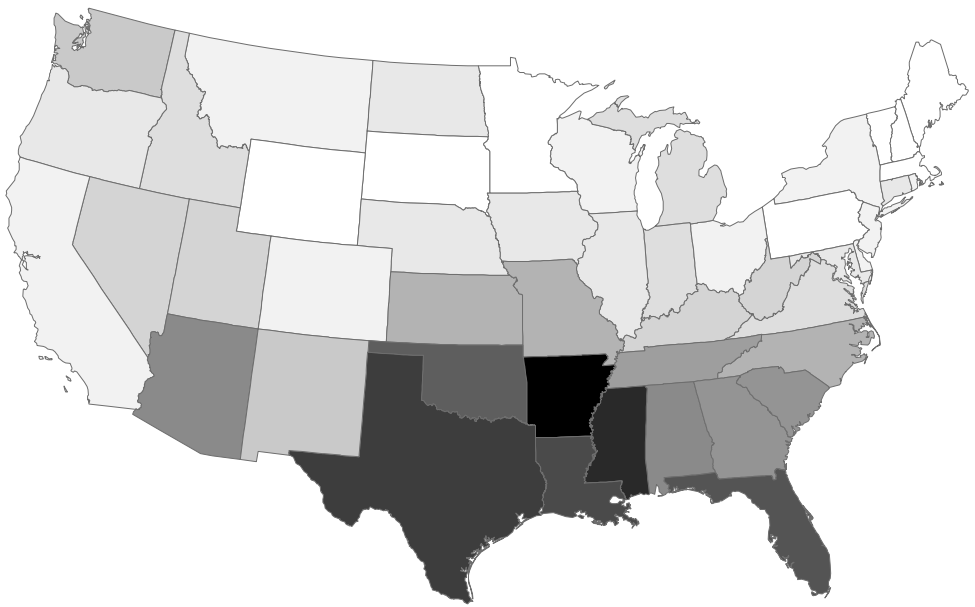
# Second Difference: Spatial Variation

- Imagine eradication was *total* eradication
- Then places with lots of malaria prior to eradication had 'further to fall'
- This means we should expect to see larger effects (on, eg, child learning) of the program in places where malaria was worse to begin with.

# Second Difference: Spatial Variation

## There was significant pre-eradication variation in malaria across regions: USA

Figure B – 1: Malaria Intensity by State in the United States

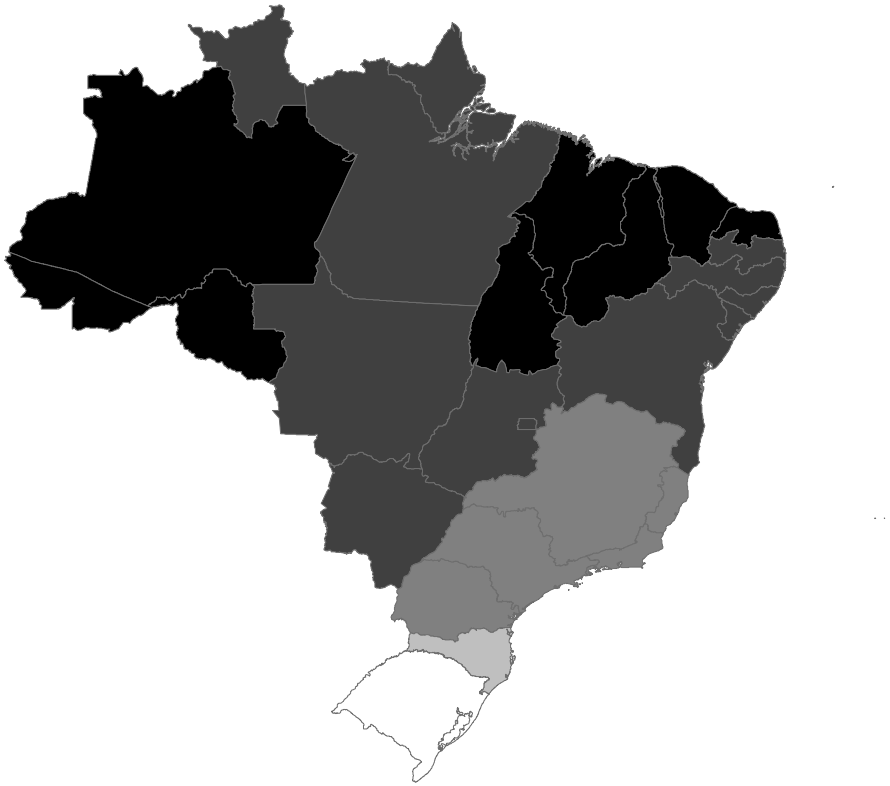


Notes: Displays a map of the ratio of malaria mortality to total mortality by state *circa* 1890. Source: U.S. Bureau of the Census (1894). Darker colors indicate more malaria.

# Second Difference: Spatial Variation

## There was significant pre-eradication variation in malaria across regions: Brazil

Figure B – 2: Malaria Intensity by State in Brazil

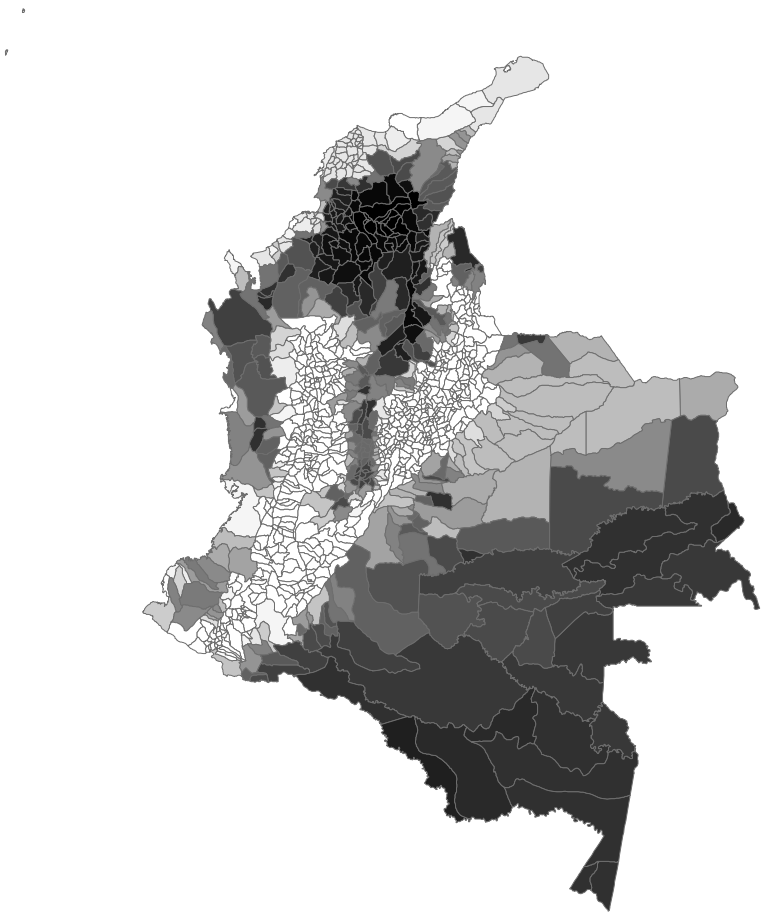


Notes: Displays a map of an index of malaria ecology as constructed by Mellinger *et al.* (2004). Darker colors indicate climatic and geographic conditions more conducive to the transmission of malaria.

# Second Difference: Spatial Variation

## There was significant pre-eradication variation in malaria across regions: Colombia

Figure B – 3: Malaria Intensity by Municipio in Colombia



# Second Difference: Spatial Variation

## There was significant pre-eradication variation in malaria across regions: Mexico

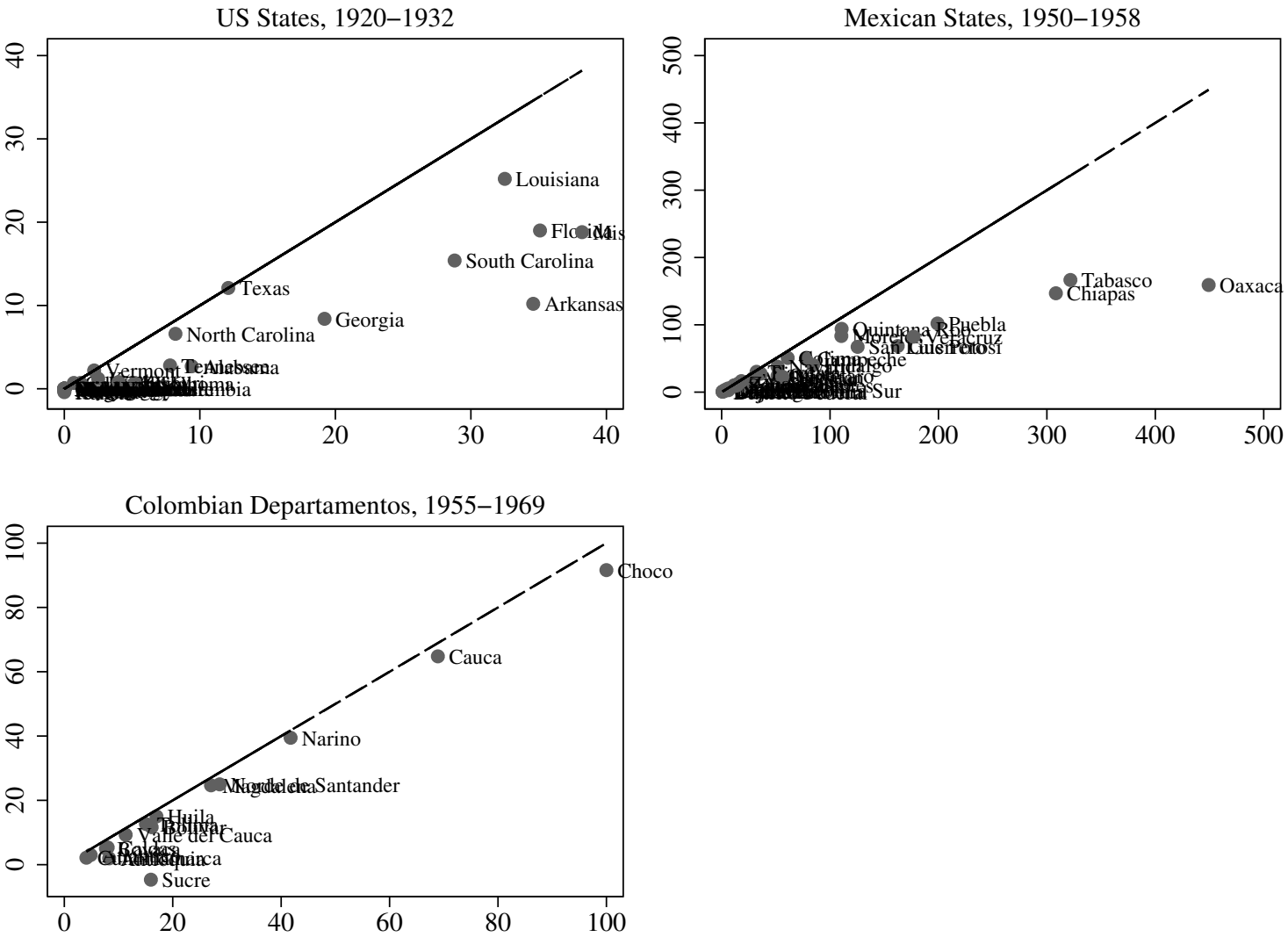
Figure B – 4: Malaria Intensity by State in Mexico

Displays a map of malaria mortality per capita, *circa* 1950. Source: Pesqueira (1957). Darker colors indicate more malaria.

# Second Difference: Spatial Variation

## The harder they come, the harder they fall?

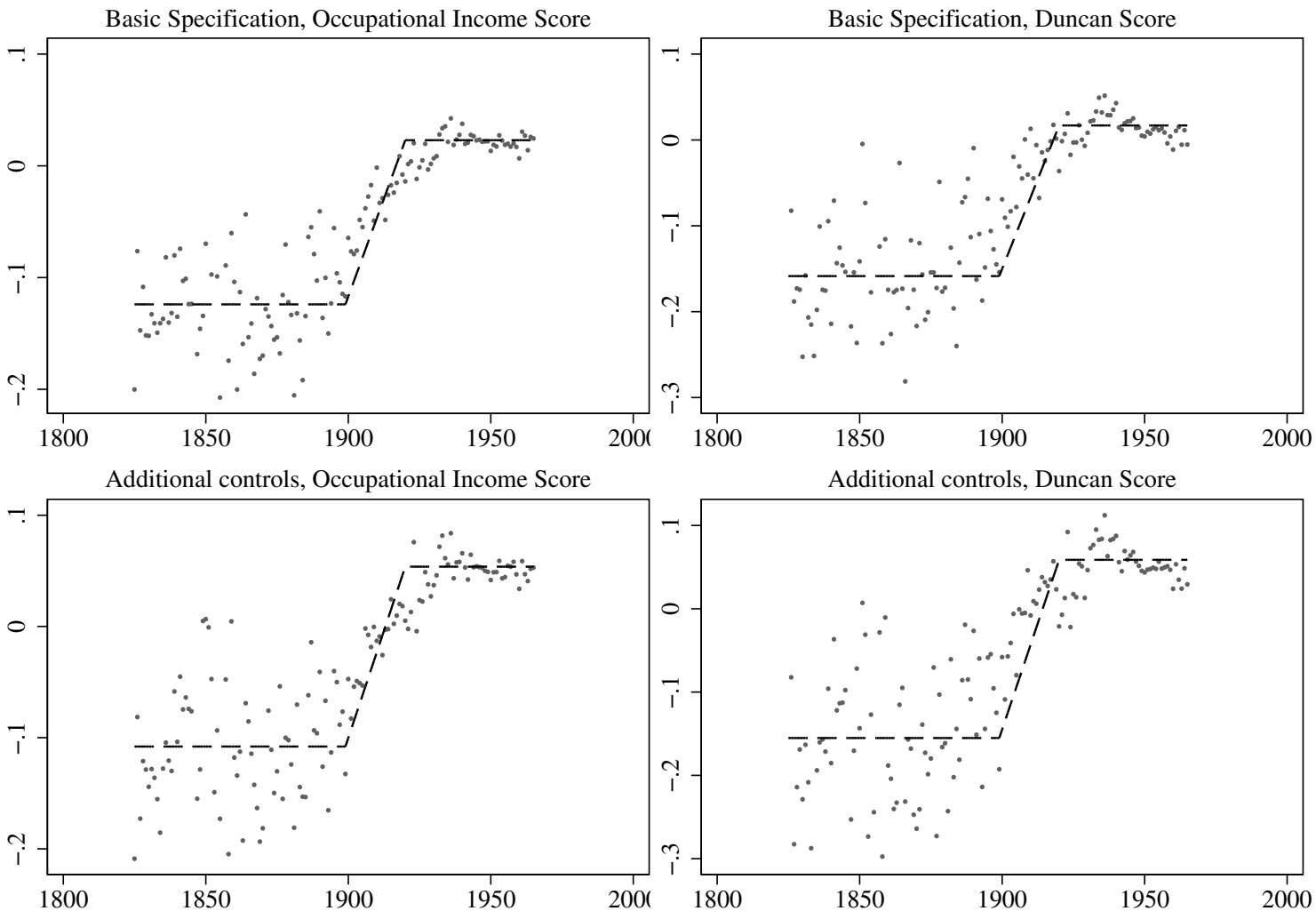
Figure 2: Highly Infected Areas Saw Greater Declines in Malaria



# Results: Income

## US South

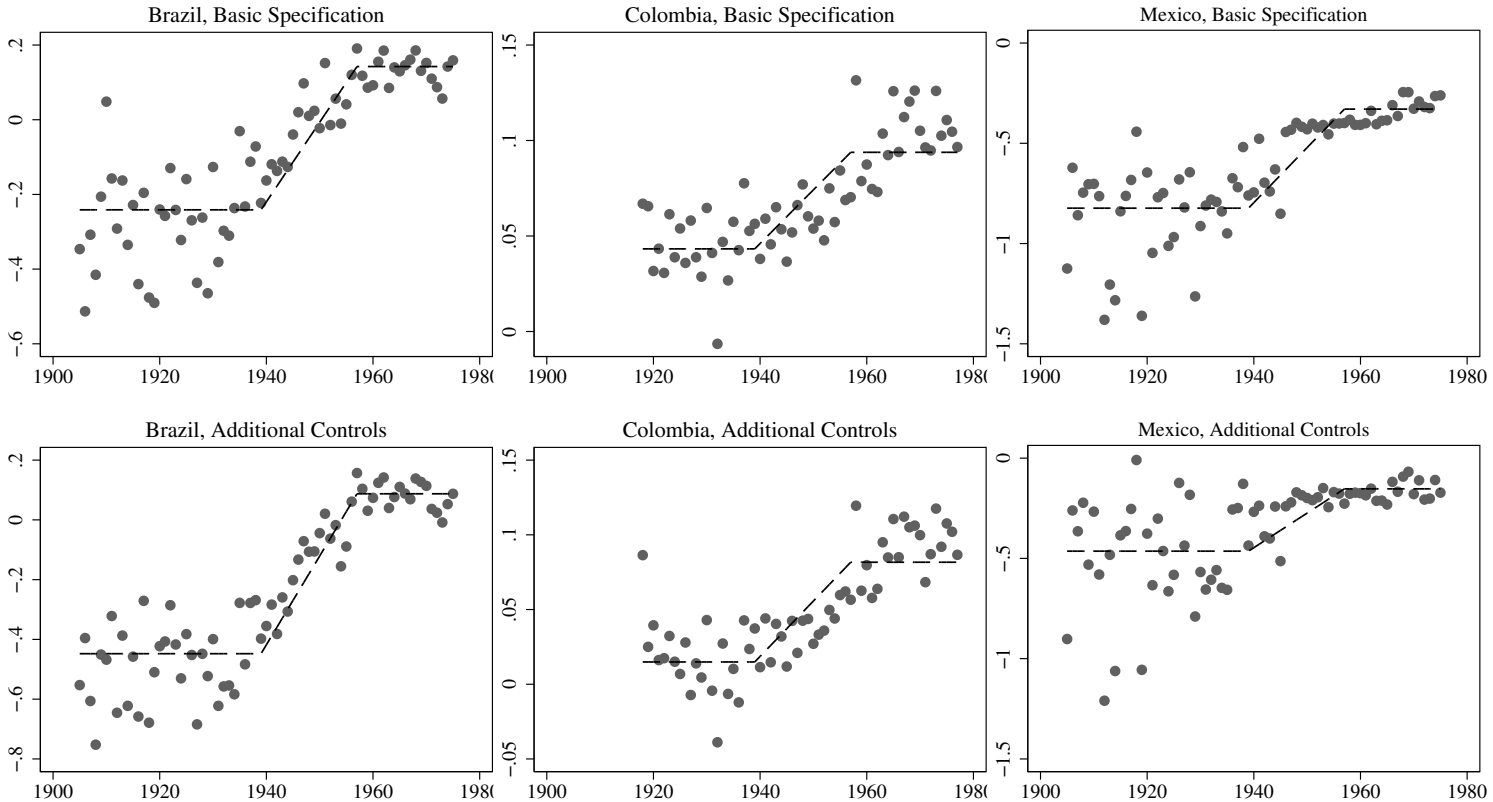
Figure 4: Cohort-Specific Relationship: Income across States in the U.S.



# Results: Income

## Brazil, Colombia, Mexico

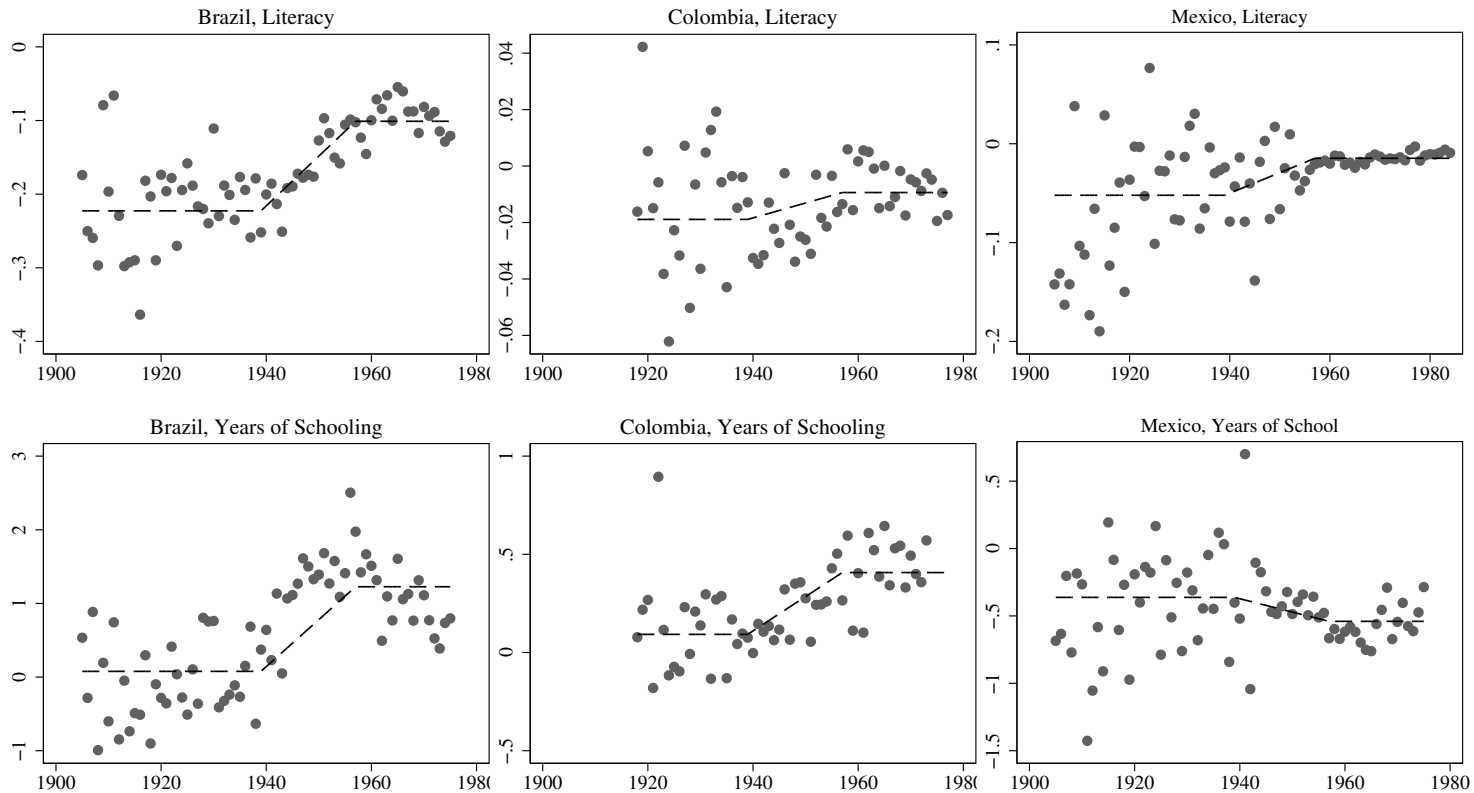
Figure 5: Cohort-Specific Relationship: Income in Brazil, Colombia, and Mexico



# Results: Literacy and Schooling

## Brazil, Colombia, Mexico

Figure 6: Cohort-Specific Relationship: Human Capital in Brazil, Colombia, and Mexico



# Puzzling Results on Schooling Attendance?

# Acemoglu-Johnson

# Differences From Bleakley

- Macro data: Entire country (not regions of country or cohorts of a country)
- Outcomes (eg GDP) measured in real time—not a cross-cohort analysis based on effect of childhood exposure on outcomes observed later (eg adult wages)
- Different question: effect of eradication of *fatal* diseases (ie raising *life expectancy*): mortality rather than morbidity

# Life Expectancy and GDP Levels: Theory

- Why would we expect to see (or not to see) an effect of improved life expectancy on GDP growth?

# Life Expectancy and GDP Levels: Empirics

- There is a positive correlation between life expectancy and GDP levels across countries today
  - Why might this correlation not necessarily imply that a channel of causation is at work?
- How might we measure the amount of causation at work here?

# How This Paper Tries to Solve the Problem

- Exploit the 'Epidemiological Transition' (c. 1940s):
  - Dramatic improvement in: international health interventions, public health measures, introduction of new chemicals and drugs
  - Demographers: major cause of death switched from infectious diseases to degenerative diseases
  - Diseases such as TB, malaria and pneumonia receded
  - Each disease went through its own 'major global intervention'
- Potential effect of epidemiological transition varied across countries depending on their pre-transition disease mix

# Predicted Mortality Drop

- Authors construct measure of 'predicted mortality' in each country $i$ and year $t$ as follows:

$$M'_{it} = \sum_{d=1}^{15} [(1 - I_{dt}) M_{di40} + I_{dt} M_{dFt}] \quad (1)$$

- Where:
  - $d$ is for disease (of which there are 15: TB, malaria, pneumonia, influenza, cholera, typhoid, smallpox, whooping cough, measles, diptheria, scarlet fever, yellow fever, plague, typhus fever and dysentery/diarrhoeal disease)
  - $I_{dt}$: 'dummy variable' equal to 1 if year $t$ is after the year in which disease $d$ had its global intervention (eg DDT for malaria)
  - $M_{di40}$: death rate due to disease $d$ in country $i$ in year 1940 (pre-intervention)
  - $M_{dFt}$: death rate due to disease $d$ in the frontier (ie lowest death rate) country in year $t$

# Predicted Mortality: an Instrumental Variable

- We are interested in the causal effect of $LE$ (life expectancy) on $Y$ (GDP per capita)
- We can construct the correlation between $LE$ and $Y$—but we worry this is not equal to the causal effect
- Sometimes we can find an 'instrumental variable' $M'$ which satisfies two conditions/assumptions:
  1. $M'$ is correlated with $LE$ [testable]
  2. The *only* reason that $M'$ is correlated with $Y$ is because $M'$ shifts $LE$, and $LE$ shifts $Y$ [not testable]
- Under these conditions/assumptions you can back out the extent to which $LE$ shifts $Y$, ie the causal effect of $LE$ on $Y$ (the thing we're interested in).

# Predicted Mortality: an Instrumental Variable

- How plausible is condition 2 here? Recall 2: "The *only* reason that $M'$ is correlated with $Y$ is because $M'$ shifts $LE$, and $LE$ shifts $Y$"
- Authors are claiming:
  1. Timing of disease intervention (ie the $I_{dt}$ variable) was completely out of the control of these countries
  2. Pre-intervention (ie 1940) 'disease mix' (ie the $M_{di40}$ variables) does not affect post-1940 economic growth ($Y$)
  3. Hence, 'predicted mortality' is *exogenous* with respect to economic growth ($Y$)
  4. Further, the only thing that 'predicted mortality' (ie a country's particular exposure to the disease interventions) did to economic growth was to raise life expectancy $LE$

# 'First Stage' and 'Reduced-Form'

- These are names given to different correlations in the data among $LE$, $Y$ and $M'$
- First Stage:
  - The correlation between $LE$ and $Z$
- Reduced-form:
  - The correlation between $Y$ and $M'$
- We will look at these in the Acemoglu-Johnson data
- Intuitively, the effect of $LE$ on $Y$ (ie what we really care about) is given by the ratio of reduced-form correlation over the first stage correlation.

# Results: First-Stage Correlation

## Plot of $\Delta LE$ against $\Delta M'$

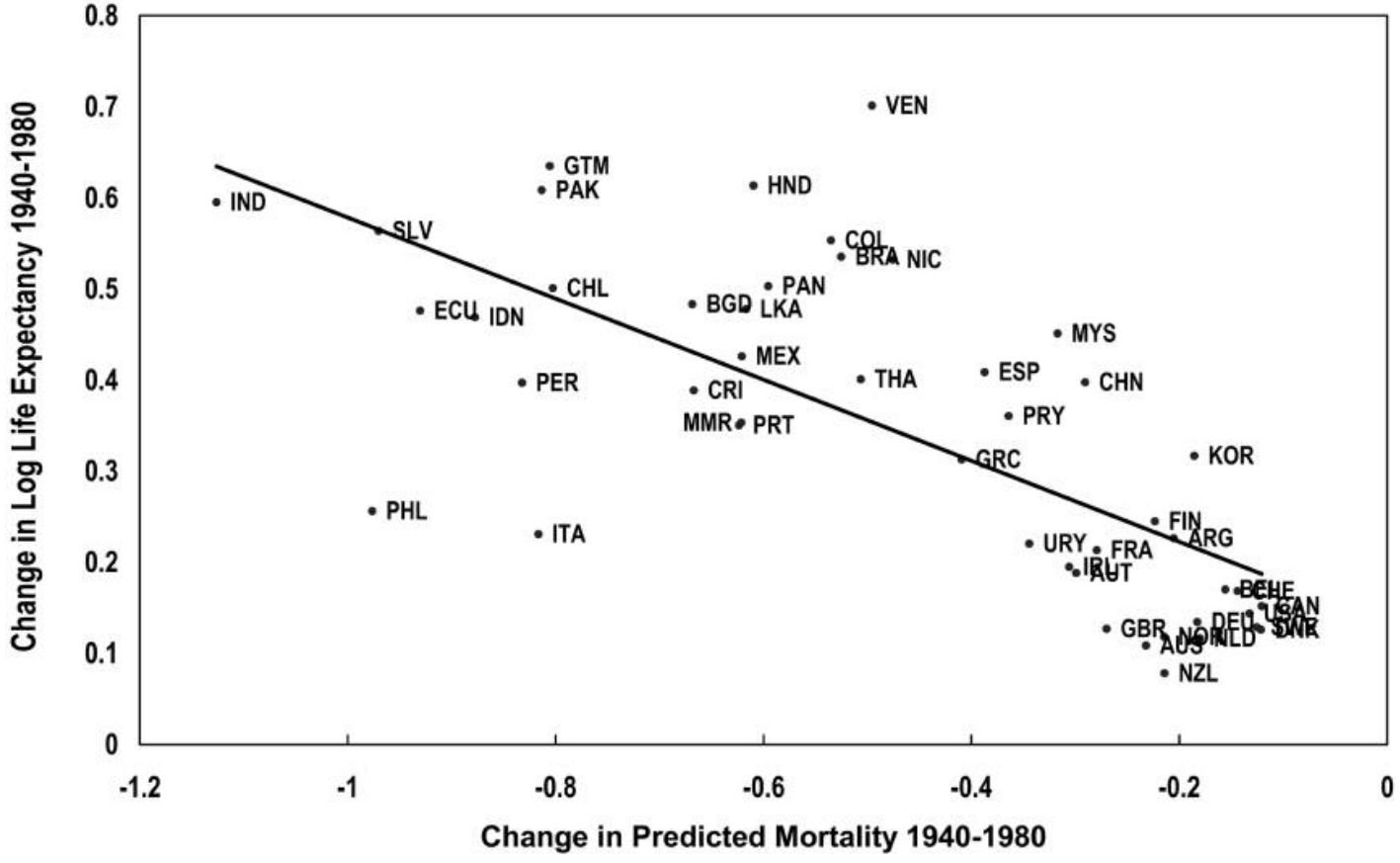



FIG. 3.—Change in log life expectancy and change in predicted mortality, 1940–80, base sample.

# Results: First-Stage Correlation

## A check: is 'predicted mortality' predicting the past (1900-1940)?

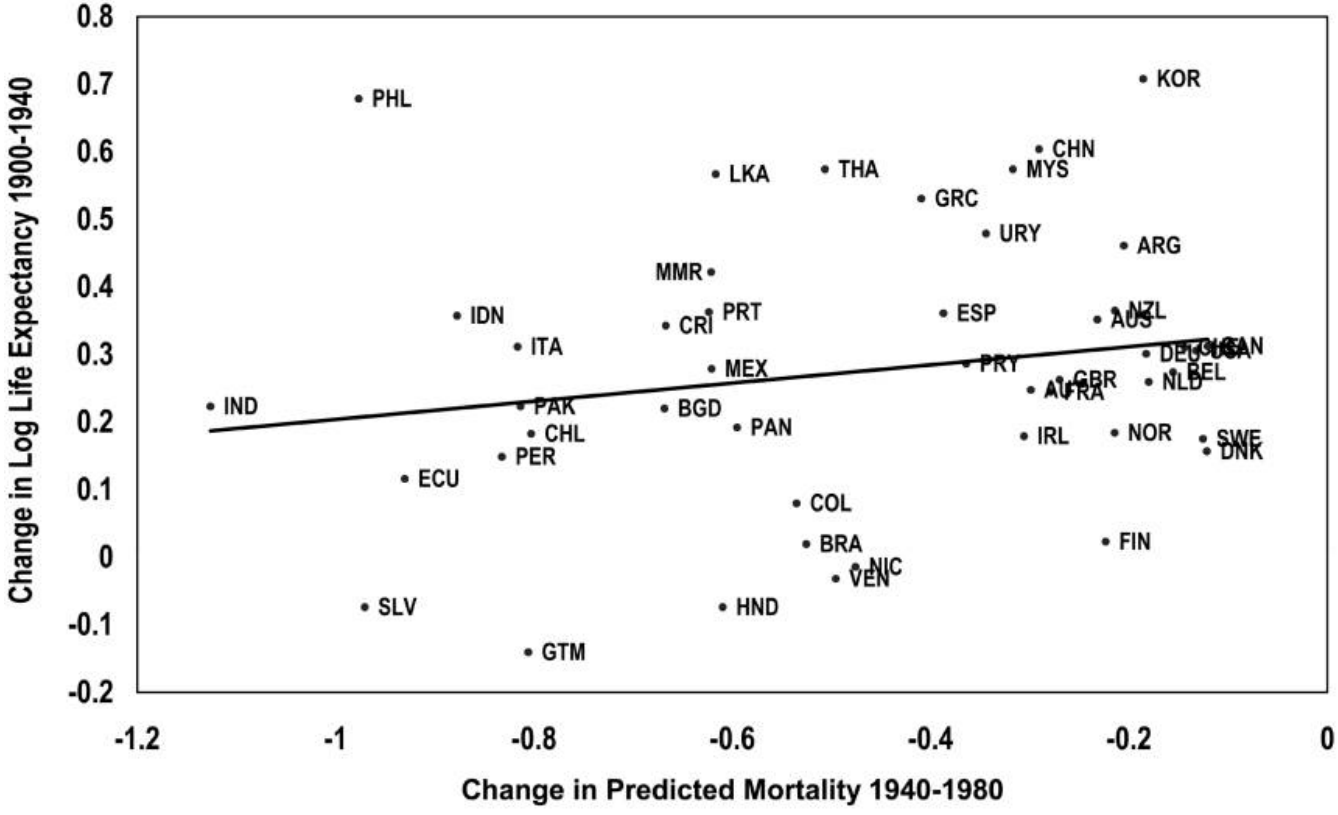



FIG. 5.—Change in log life expectancy 1900–1940 and change in predicted mortality, 1940–80, base sample.

# Results: First-Stage Correlation

## A check: is 'predicted mortality' predicting the past (1930-1940)?

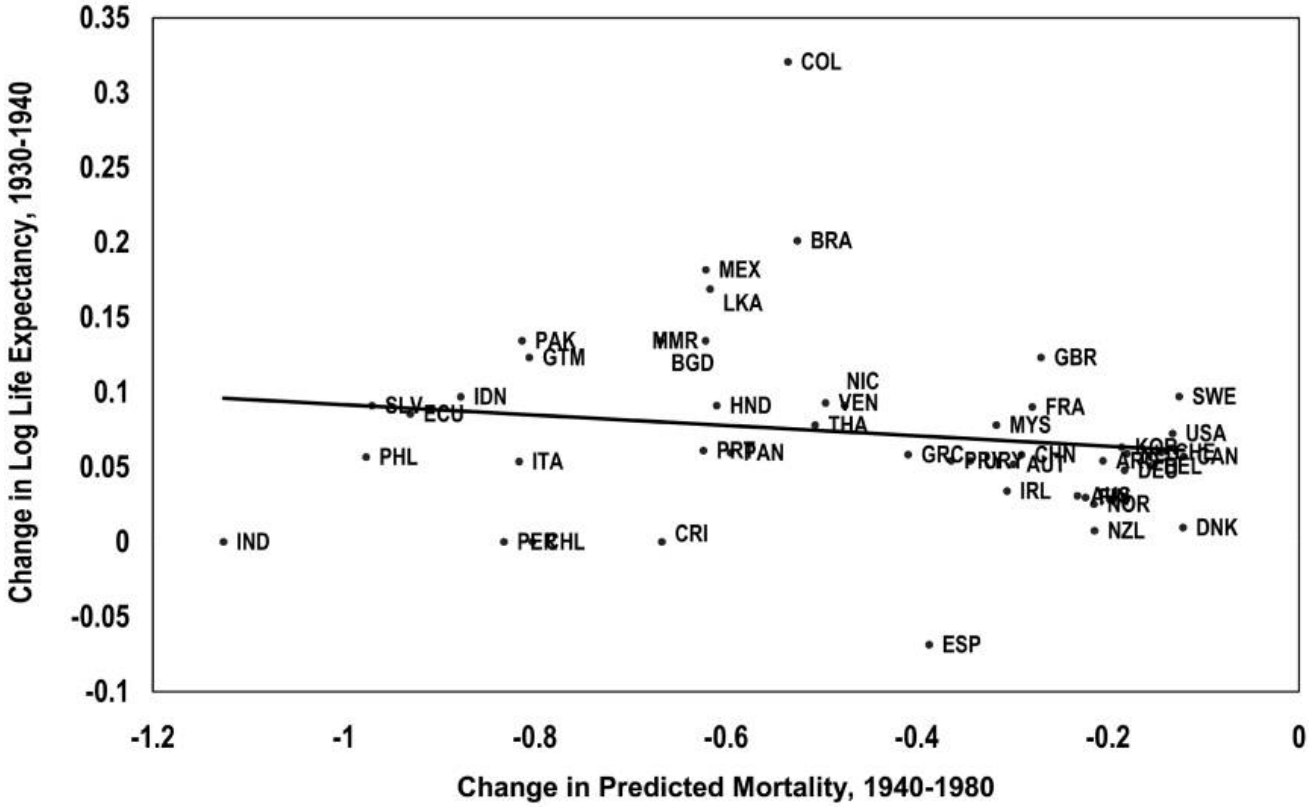



FIG. 6.—Change in log life expectancy, 1930–40, and change in predicted mortality, 1940–80, base sample.

# Results: Reduced-form Correlation for Population

## Plot of $\Delta Y$ against $\Delta M'$, where $Y$ = population

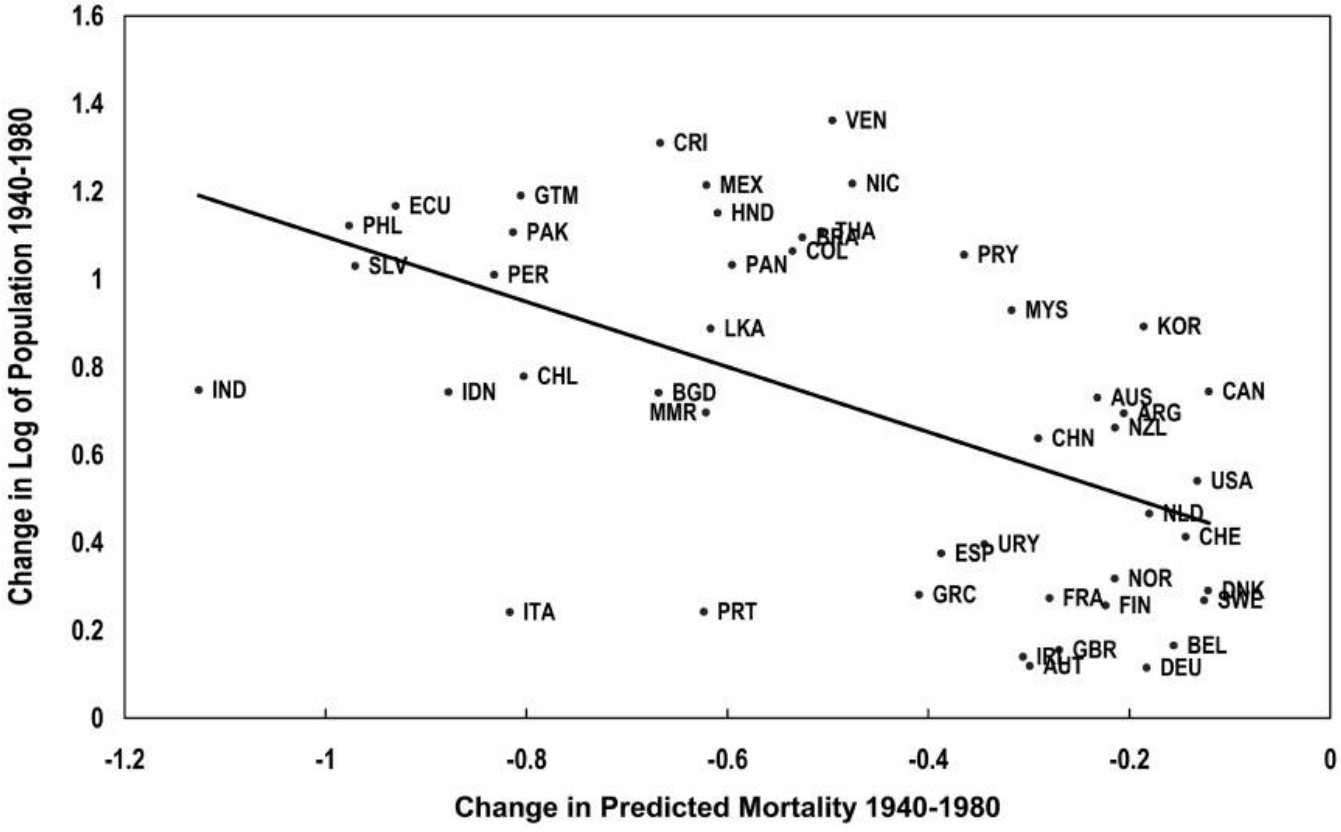



FIG. 7.—Change in log of population and change in predicted mortality, 1940–80, base sample.

# Results: IV Estimate for Population

- So what is the effect of life expectancy on population?
- Is this surprising?

# Results: Reduced-form Correlation for GDP

## Plot of $\Delta Y$ against $\Delta M'$, where $Y$ = GDP

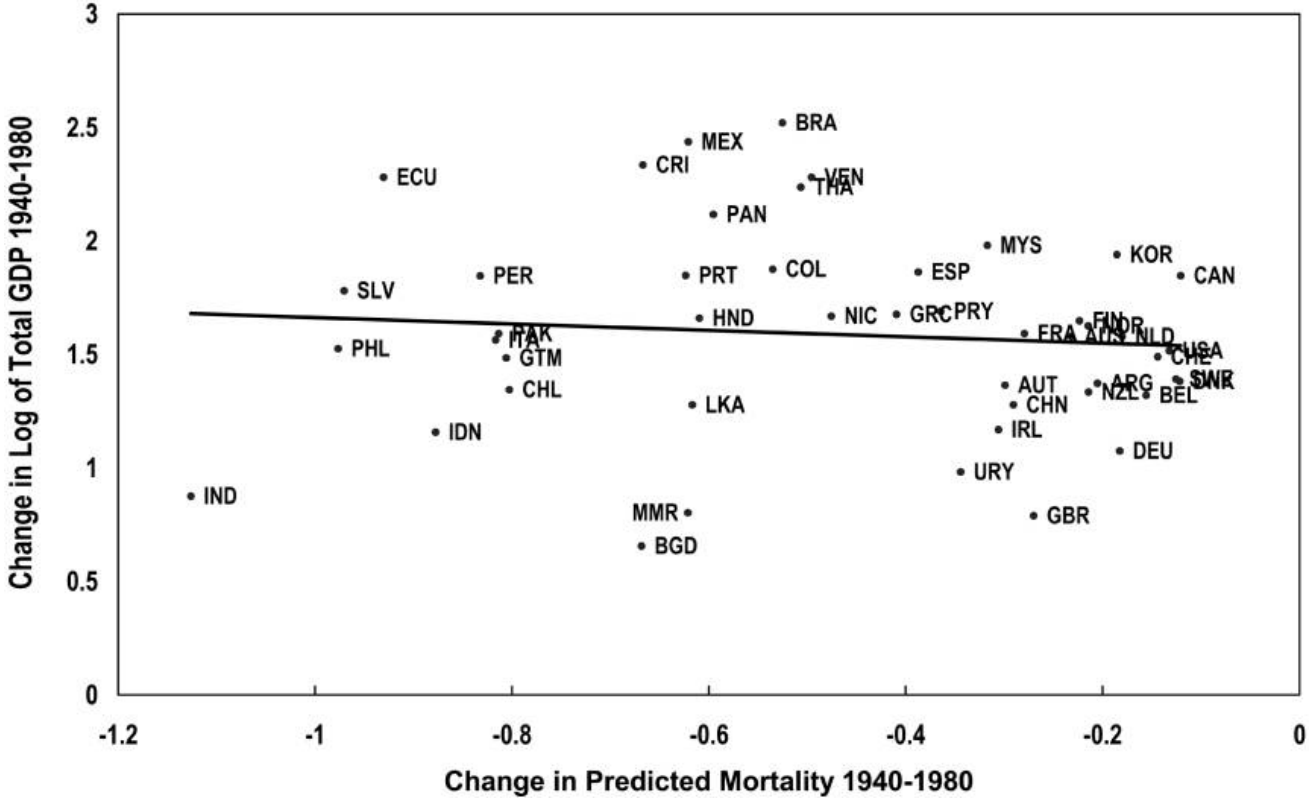



FIG. 8.—Change in log of total GDP and change in predicted mortality, 1940–80, base sample.

# Results: IV Estimate for GDP and GDP per capita

- So what is the effect of life expectancy on GDP?
  - Is this surprising?
- What about the effect of life expectancy on GDP *per capita*?
  - Is this surprising?

# Bleakley vs Acemoglu-Johnson

Why do these studies find different things?

# Bleakley vs Acemoglu-Johnson

Why do these studies find different things?

- Different diseases?
- Mortality vs Morbidity
- Micro vs Macro approaches
  - Bleakley compares young with old (a 'micro' comparison): young (exposed to eradication) earn more than old (not exposed)
  - Any effect of malaria eradication that affects young and old equally will be differenced out and not counted.
  - Perhaps both young and old are affected adversely (and equally) by the presence of higher population (the 'macro' effect found in Acemoglu-Johnson)