Lecture 9:
Barriers to Riches

Macroeconomics (Quantitative)
Econ 101B

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Two Key Questions about Growth

- What determines the growth of the “frontier”?

  (Market for Ideas)

- Why are some countries so far behind the frontier?

  (Barriers to Riches)

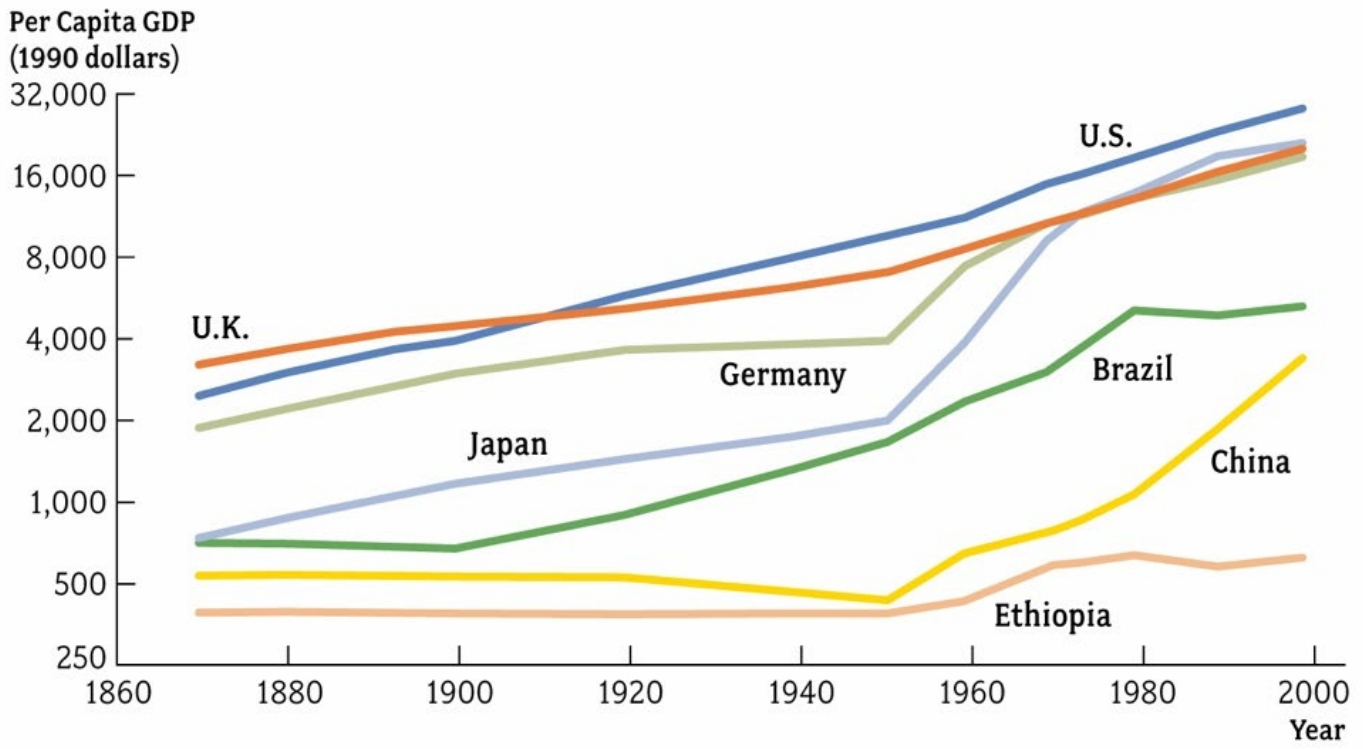


FIGURE 1.1 **Per Capita GDP in Seven Countries, 1870–2000**

Macroeconomics, Charles I. Jones

Proximate vs. Fundamental Causes

Research on income differences can arguably be classified into one or more arrows in the following chain of causality:

$$\begin{array}{l} \textit{Geography, Climate, Luck} \Rightarrow \textit{Human Capital, Physical Capital, TFP} \Rightarrow \textit{Income} \\ \quad \Downarrow \\ \textit{Institutions, Culture} \Rightarrow \textit{Human Capital, Physical Capital, TFP} \Rightarrow \textit{Income} \\ \quad \Downarrow \\ \textit{Policies, Rule of Law, Corruption} \Rightarrow \textit{Human Capital, Physical Capital, TFP} \Rightarrow \textit{Income} \end{array}$$

Development Accounting

- Production function for country i:

$$Y_i = A_i^{1-a} K_i^a H_i^{1-a}$$

  - Human capital: $H_i = h_i L_i$
  - Human capital per person: h_i (often proxied by years of schooling)
  - Raw labor: L_i (workers or hours of labor)
- Divide by Y_i^a and then raise both sides to power $1/(1-a)$:

$$Y_i^{1-a} = A_i^{1-a} \left(\frac{K_i}{Y_i}\right)^a H_i^{1-a} \quad \rightarrow \quad Y_i = A_i \left(\frac{K_i}{Y_i}\right)^{\frac{a}{1-a}} H_i$$

Development Accounting

- Divide through by L_i:

$$y_i = A_i \left(\frac{K_i}{Y_i} \right)^{\frac{a}{1-a}} h_i$$

- Decomposes output per worker y_i into
  - Productivity: A_i
  - Capital-output ratio: K_i/Y_i
  - Human capital per worker: h_i
- Development accounting asks how much of differences in output per worker are due to each of these three factors

Development Accounting

$$y_i = A_i \left(\frac{K_i}{Y_i} \right)^{\frac{a}{1-a}} h_i$$

- Penn World Tables dataset gathers data on:
  - Output: Y_i
  - Number of workers: L_i
  - Capital: K_i
  - Average level of schooling: h_i
- Choose a value for a (e.g., 1/3)
- We treat A_i as a residual

Table 6 Basic development accounting, 2010

	GDP per worker, y	Capital/GDP $(K/Y)^{\alpha/(1-\alpha)}$	Human capital, h	TFP	Share due to TFP
United States	1.000	1.000	1.000	1.000	–
Hong Kong	0.854	1.086	0.833	0.944	48.9%
Singapore	0.845	1.105	0.764	1.001	45.8%
France	0.790	1.184	0.840	0.795	55.6%
Germany	0.740	1.078	0.918	0.748	57.0%
United Kingdom	0.733	1.015	0.780	0.925	46.1%
Japan	0.683	1.218	0.903	0.620	63.9%
South Korea	0.598	1.146	0.925	0.564	65.3%
Argentina	0.376	1.109	0.779	0.435	66.5%
Mexico	0.338	0.931	0.760	0.477	59.7%
Botswana	0.236	1.034	0.786	0.291	73.7%
South Africa	0.225	0.877	0.731	0.351	64.6%
Brazil	0.183	1.084	0.676	0.250	74.5%
Thailand	0.154	1.125	0.667	0.206	78.5%
China	0.136	1.137	0.713	0.168	82.9%
Indonesia	0.096	1.014	0.575	0.165	77.9%
India	0.096	0.827	0.533	0.217	67.0%
Kenya	0.037	0.819	0.618	0.073	87.3%
Malawi	0.021	1.107	0.507	0.038	93.6%
Average	0.212	0.979	0.705	0.307	63.8%
1/Average	4.720	1.021	1.418	3.260	69.2%

Source:
Jones (2016)

Development Accounting

- Difference in output per worker across countries factor of 50
- None of this is due to low capital-output ratio
  - Poor countries seem not to be poor because they lack capital
- Factor of 2 due to difference in human capital
  - Lack of education plays some role in poor countries being poor
- Factor of 25 due to difference in productivity
  - Productivity (“measure of our ignorance”) explains bulk of difference

Agriculture and Development

- Most people in poor countries work in agriculture
- Classic view of development: Reallocation out of agriculture into “modern” sectors
- But what is holding that back?

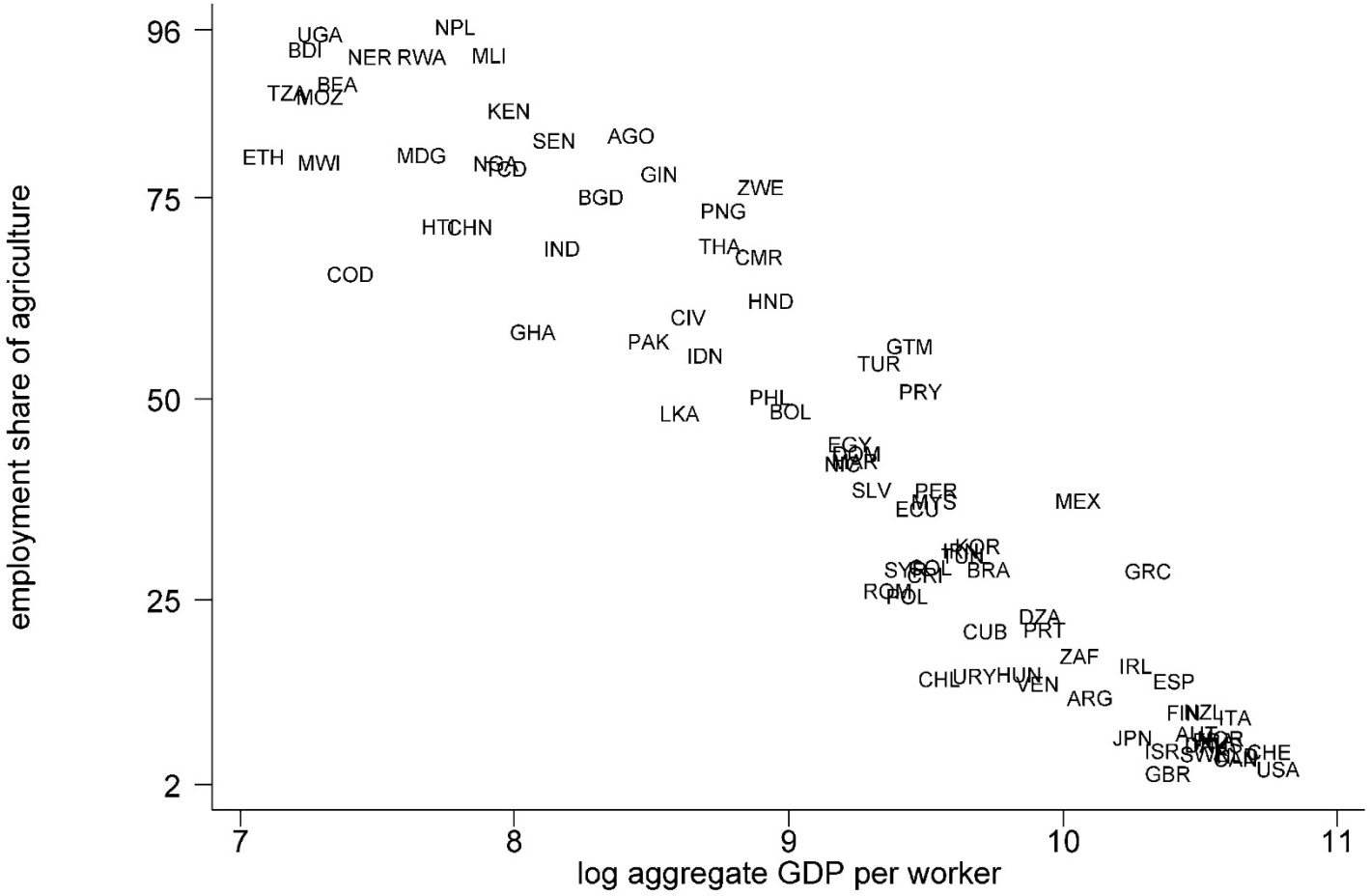


Figure 15. The importance of agriculture.

Source: Caselli (2005)

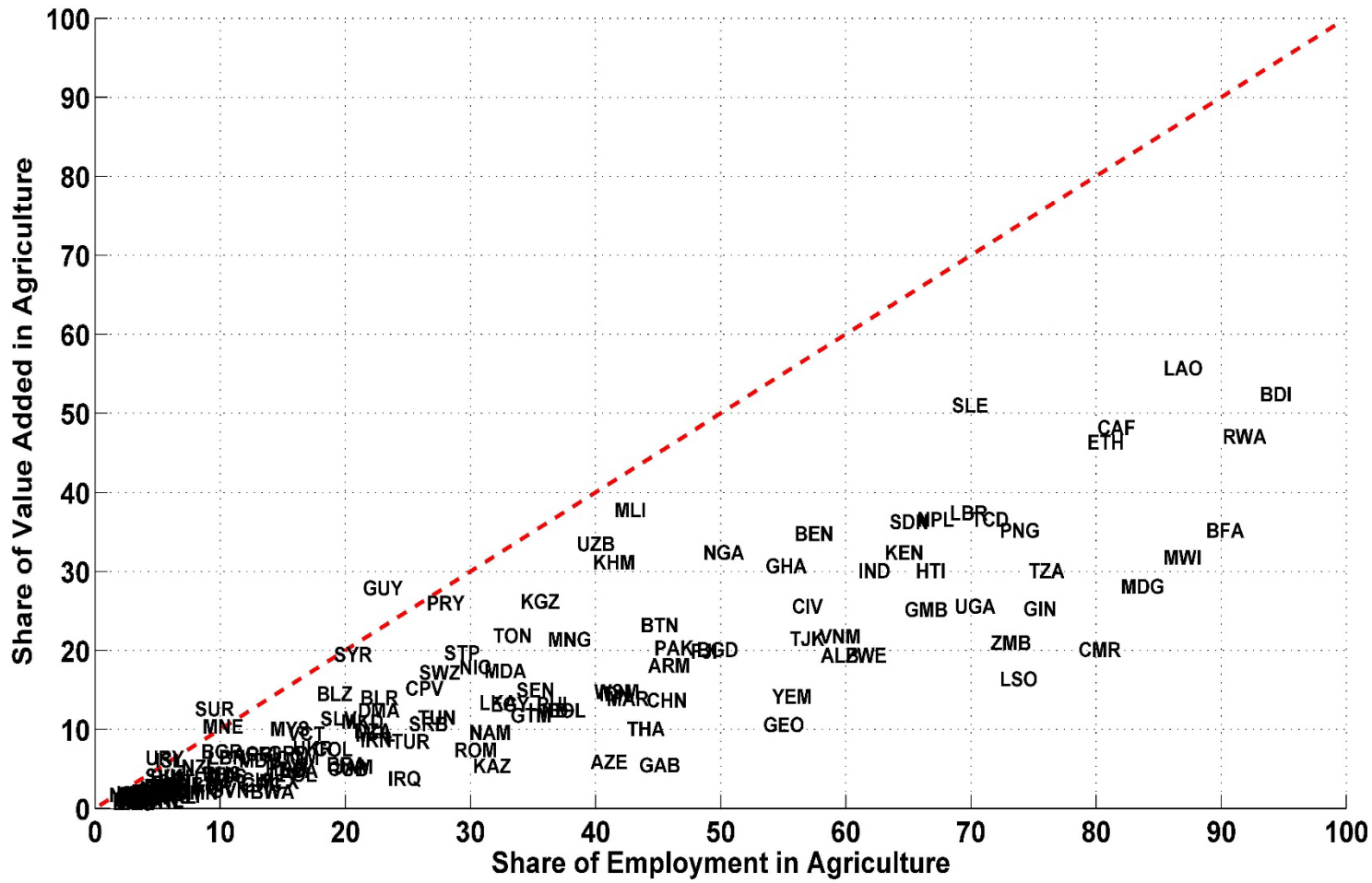
Agriculture and Development: Two Views

1. Unproductive urban sector is the problem
   - Urban sector can't absorb labor
   - Urban sector unproductive or can't grow fast enough
   - People in country-side are "army of surplus labor"
2. Unproductive agricultural sector is the problem
   - Labor needed to produce food ("food problem")
   - Agricultural sector can't shed labor

- Unclear which of these stories is more important

Agricultural Productivity Gap

- Value added per worker is much lower in agriculture than in other sectors
- Why don't workers leave the agricultural sector?
- Poor countries employ most workers in sector that they are particularly unproductive in
- Deviation from comparative advantage



Source: David Lagakos

Barriers to Riches

Proximate Causes:

- Not capital
- Education perhaps factor of 2
- Mostly “productivity” (whatever that is)

- Most people in poor countries work in unproductive agriculture

Fundamental Causes:

- Geography
- Trade
- Institutions
- Luck (e.g., leaders)
- Culture
- Religion
- Etc.

Simple Regressions

- Cross-country regressions of growth on various candidate causes
- But everything else not equal
- Reverse causality:
  - Does democracy cause growth?
  - Or prosperity cause democracy?
- Omitted variables bias:
  - Omitted factor that causes both growth and variable of interest

Table 1.1
Regressions for per capita growth rate

Independent variable	(1)	(2)
Log(GDP)	−.0254 (.0031)	−.0225 (.0032)
Male secondary and higher schooling	.0118 (.0025)	.0098 (.0025)
Log(life expectancy)	.0423 (.0137)	.0418 (.0139)
Log(GDP) * male schooling	−.0062 (.0017)	−.0052 (.0017)
Log(fertility rate)	−.0161 (.0053)	−.0135 (.0053)
Government consumption ratio	−.136 (.026)	−.115 (.027)
Rule of law index	.0293 (.0054)	.0262 (.0055)
Terms of trade change	.137 (.030)	.127 (.030)
Democracy index	.090 [a] (.027)	.094 (.027)
Democracy index squared	−.088 (.024)	−.091 (.024)
Inflation rate	−.043 (.008)	−.039 (.008)
Sub-Saharan Africa dummy		−.0042 [b] (.0043)
Latin America dummy		−.0054 (.0032)
East Asia dummy		.0050 (.0041)
R^2	.58, .52, .42	.60, .52, .47
Number of observations	80, 87, 84	80, 87, 84

Fundamental Causes of Growth

- Convincing evidence needs to be based on exogenous variation in candidate cause
  - Variation not related to any other potential cause
- Very hard to find exogenous variation in fundamental causes
  - Need to look for “natural experiments”
- Literature includes many creative approaches
- Here I present a few examples

Geography Clearly Exogenous

- Countries closer to the equator are poorer on average
- But why?

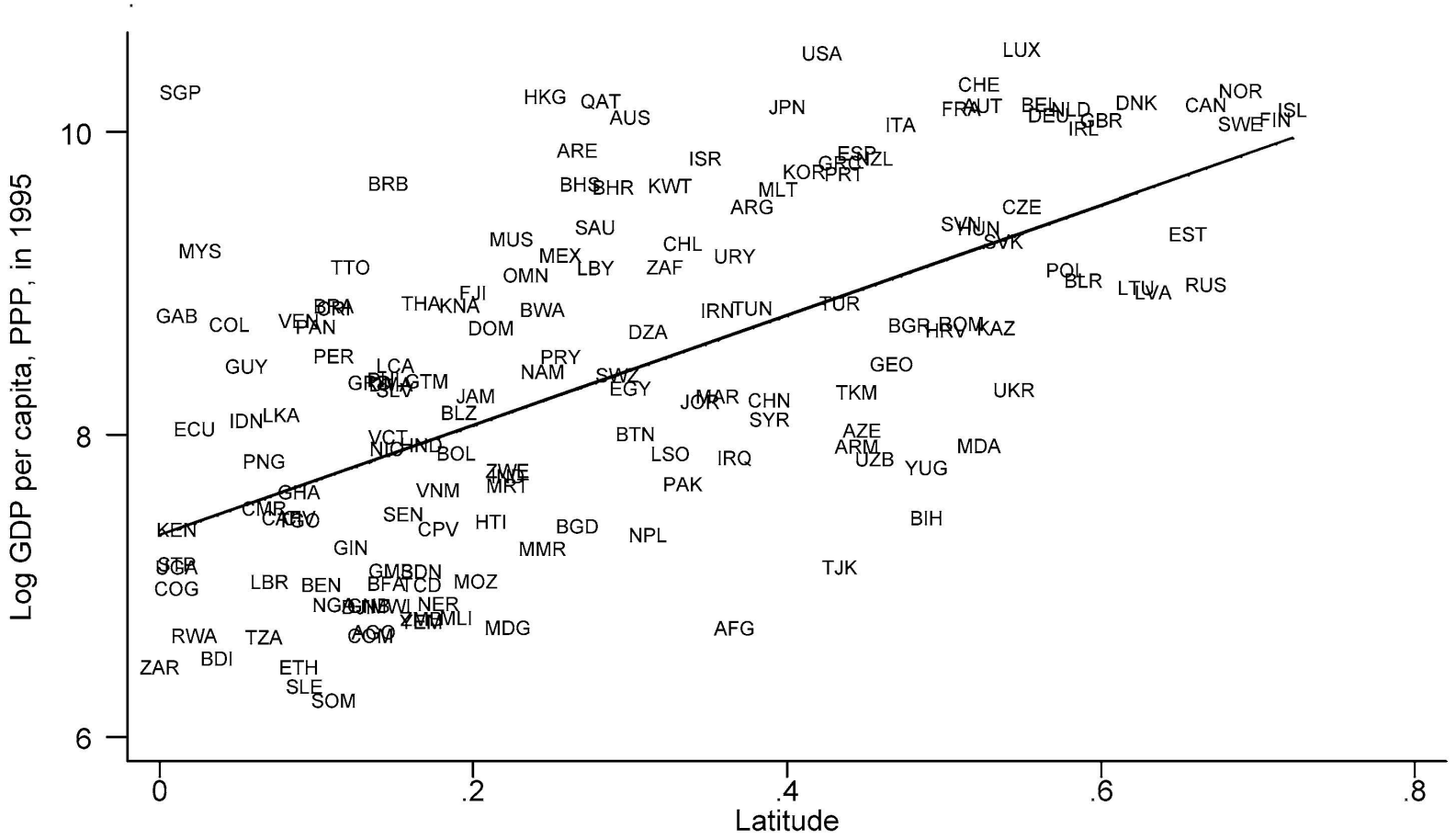
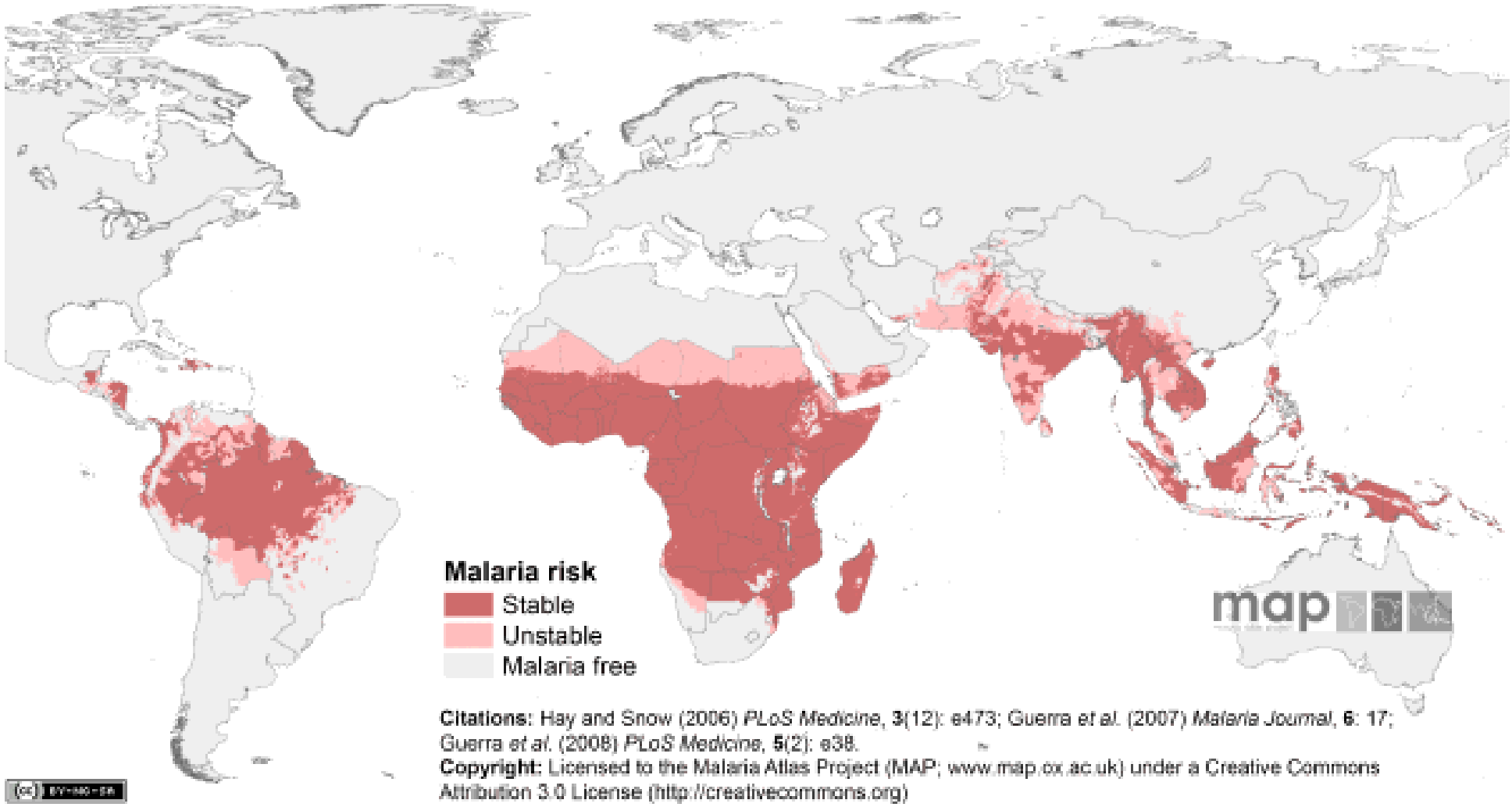


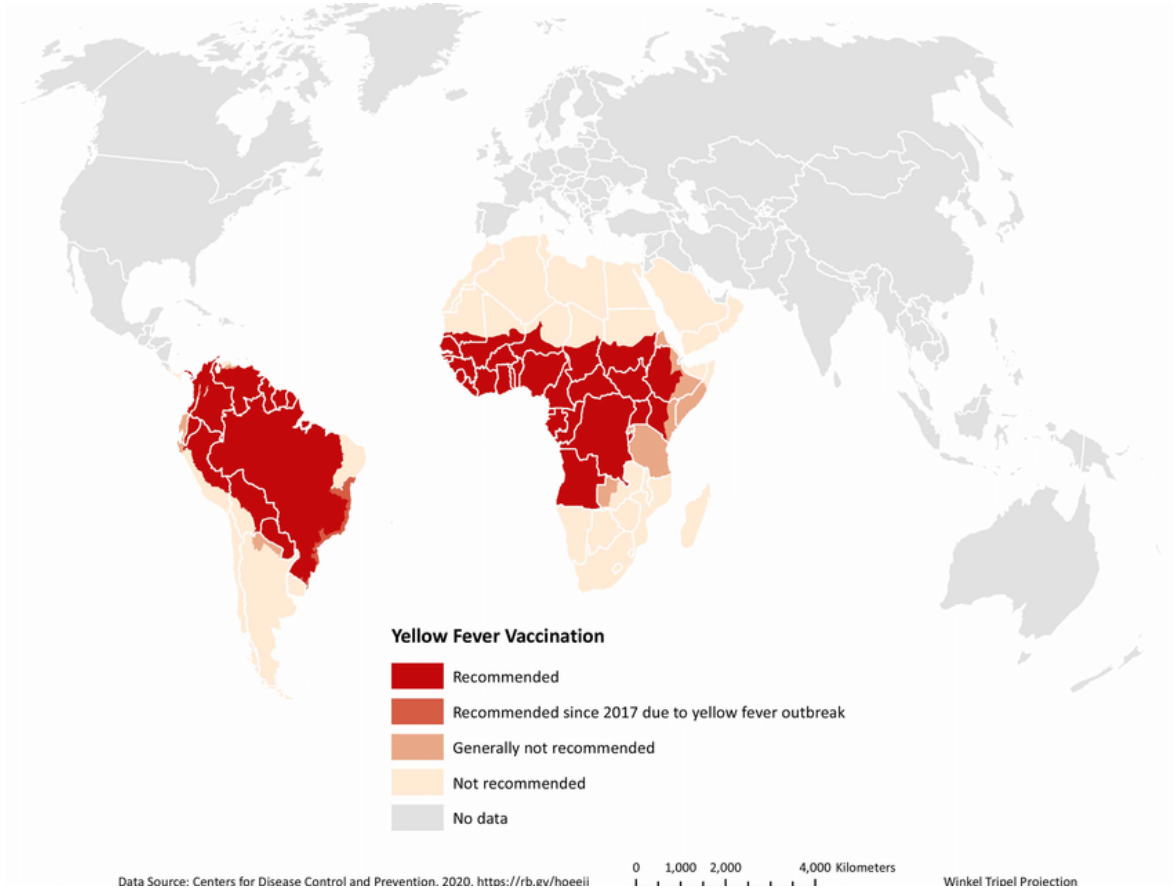
Figure 2. Latitude and log GDP per capita 1995.

Growth and Disease



Growth and Disease

Yellow Fever



Sleeping Sickness

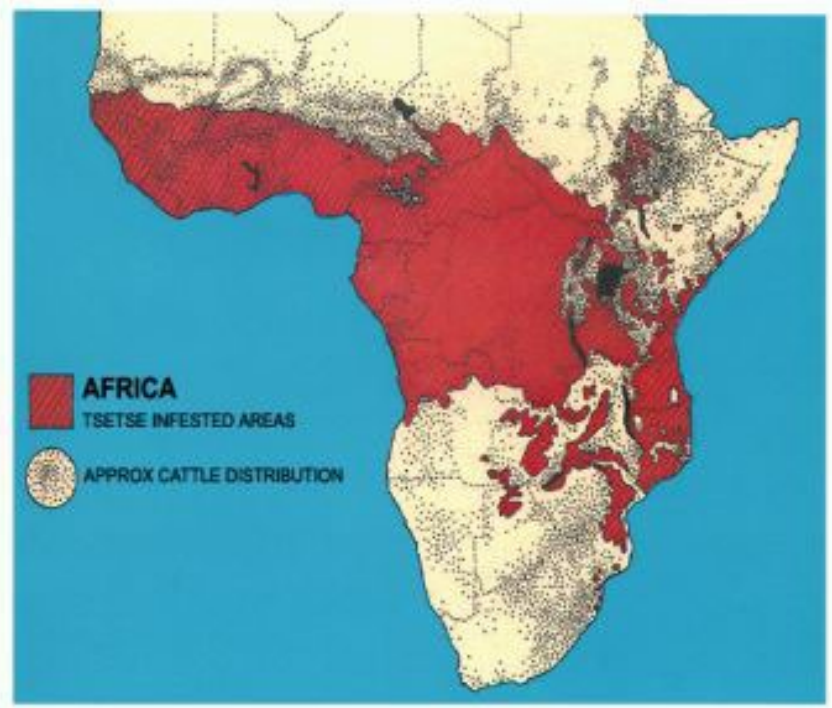


Figure 3. Impact of cattle distribution in tsetse infested areas ("Tsetse fly costs agriculture billions every year").

Geography and Growth

Channels:

- Disease
- Access to trade
- Natural resource curse

TABLE 2—CROSS-COUNTRY GROWTH REGRESSION
(DEPENDENT VARIABLE = GROWTH PER CAPITA, 1965–1990; 83-COUNTRY MEAN = 0.33 PERCENT)

Independent variable	Estimated regression coefficient
lnGDP per economically active person in 1965	−1.5 (−6.5)
Share of years open, 1965–1990	10.9 (3.7)
GDP in 1965 times share of years open	−1.1 (−3.0)
Growth of economically active population − population growth	0.7 (1.9)
Central government budget balance, 1970–1990	0.11 (5.2)
Institutional quality index (1980)	0.32 (3.8)
Tropics	−0.8 (−3.0)
Landlocked	−0.6 (−2.3)
Share of natural-resource exports in GDP, 1970	−3.9 (−4.0)
Life expectancy	0.3 (2.8)
Life expectancy squared	−0.0026 (−2.3)
Adjusted R^2:	0.84
Number of countries:	83
Standard error:	0.77

Notes: Numbers in parentheses are *t* statistics. Botswana, Gabon, Guyana, Israel, and Madagascar are outlying observations in this regression. In a regression without these countries, all coefficients have the same sign and are statistically significant.

Source: Sachs and Warner (1997)

Institutions and Growth

- Long line of thought arguing that good institutions cause high income
  - Secure property rights, rule of law, constraints on the executive
- Where do we find exogenous variation in institutions?
  - West vs. East Germany (1945-1989)
  - South vs. North Korea (post-1953)
- Suggest capitalism is good for growth

Institutions and Growth

- How can we find other exogenous variation in institutions?
- Institutions often have long term historical roots
- Institutions often have very long-lasting effects
- We consider two examples:
  - Long-term effect of Mining Mita in Peru and Bolivia
  - Long-term effect of early colonial institutions

Long Term Effects of Peru's Mining Mita

- Melissa Dell (2010): Peru's mining mita as a natural experiment for outcomes today
- Mita: Forced labor institution in Peru and Bolivia under Spanish colonial rule
- In effect from 1573 to 1812
- One-seventh of adult male population required to work in Potosi silver mines and Huancavelica mercury mine

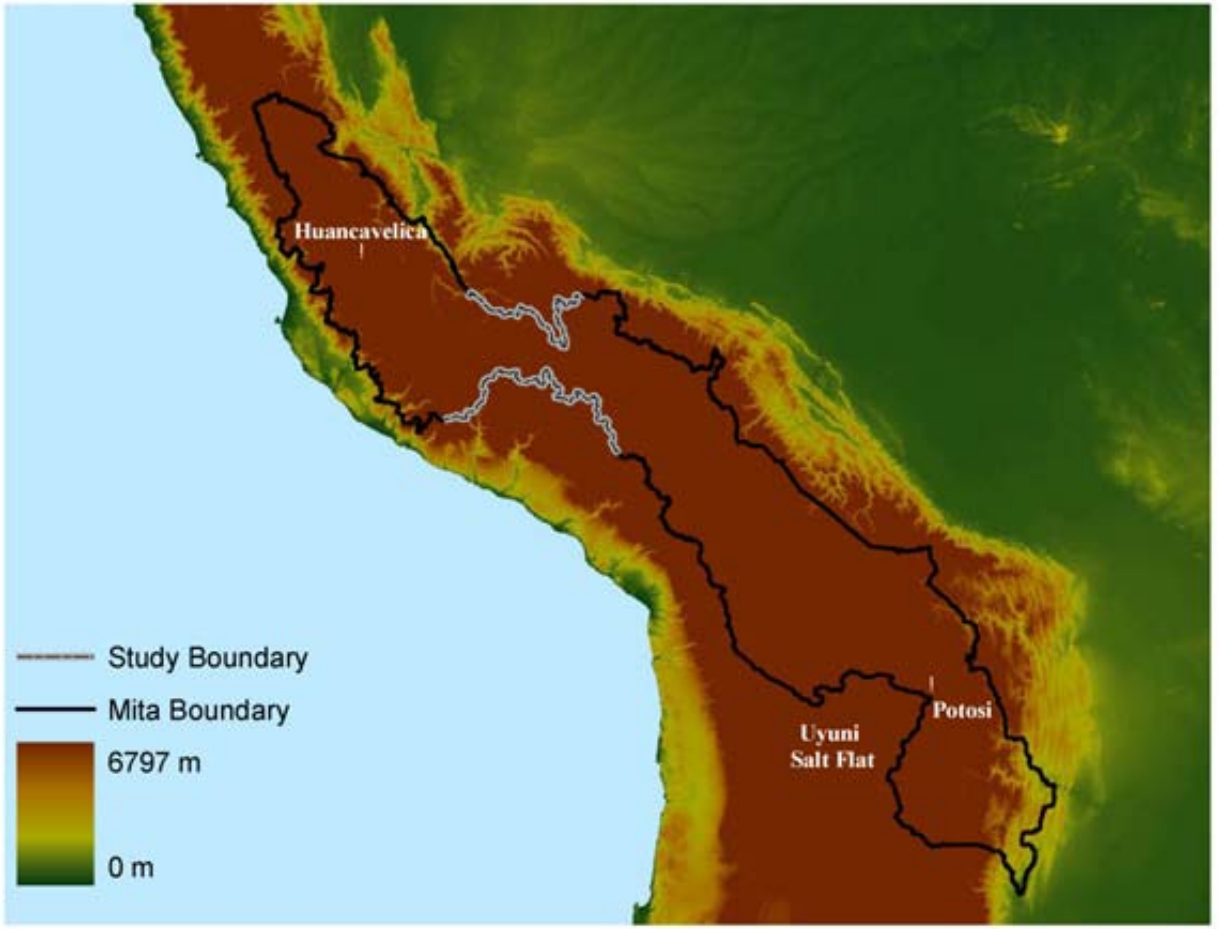


FIGURE 1.—The *mita* boundary is in black and the study boundary in light gray. Districts falling inside the contiguous area formed by the *mita* boundary contributed to the *mita*. Elevation is shown in the background.

Peru's Mining Mita

- Dell asks: What are the effects of mining mita on people living in this region today?
- How can we figure this out?
- Compare people in this region versus rest of Peru and Bolivia?
- But other things may also differ
  (e.g., altitude, fertility of soil, etc.)
- What about looking right around the edges!

Peru's Mining Mita

- If other factors change "smoothly," then we can compare area right inside catchment zone with area right outside
- Everything else should be approximately constant
- Only thing that differs is "exposure" to mita
- Method is called Regression Discontinuity Design (RD or RDD)

Peru's Mining Mita

- But perhaps catchment boundary is chosen to be at a cliff or some other place where other things change discontinuously
- Dell only studies part of catchment boundary
- Makes sure a bunch of other things are similar on both sides

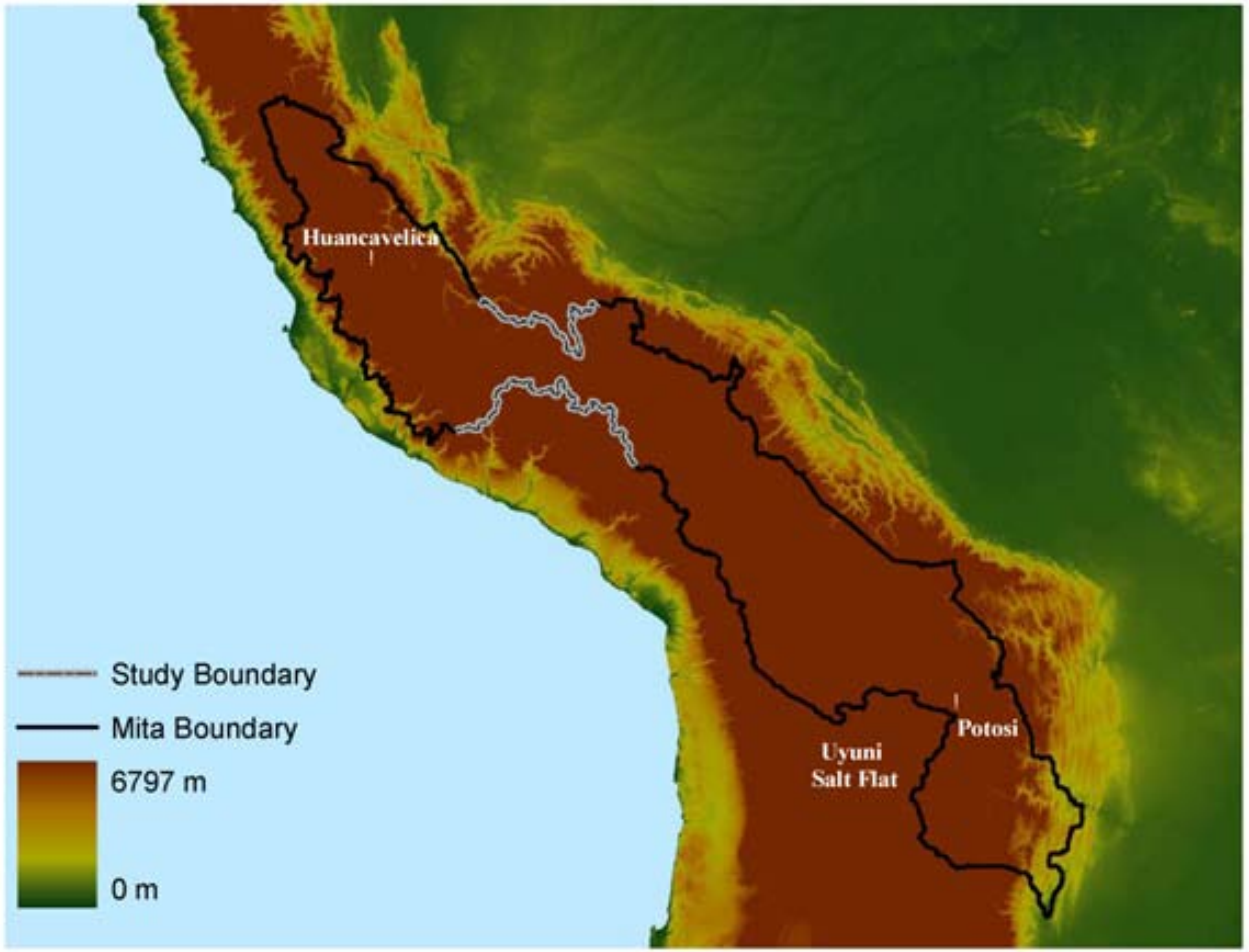


FIGURE 1.—The *mita* boundary is in black and the study boundary in light gray. Districts falling inside the contiguous area formed by the *mita* boundary contributed to the *mita*. Elevation is shown in the background.

Peru's Mining Mita

- Dell then looks at:
  - Household consumption today
  - % of children with stunted growth today

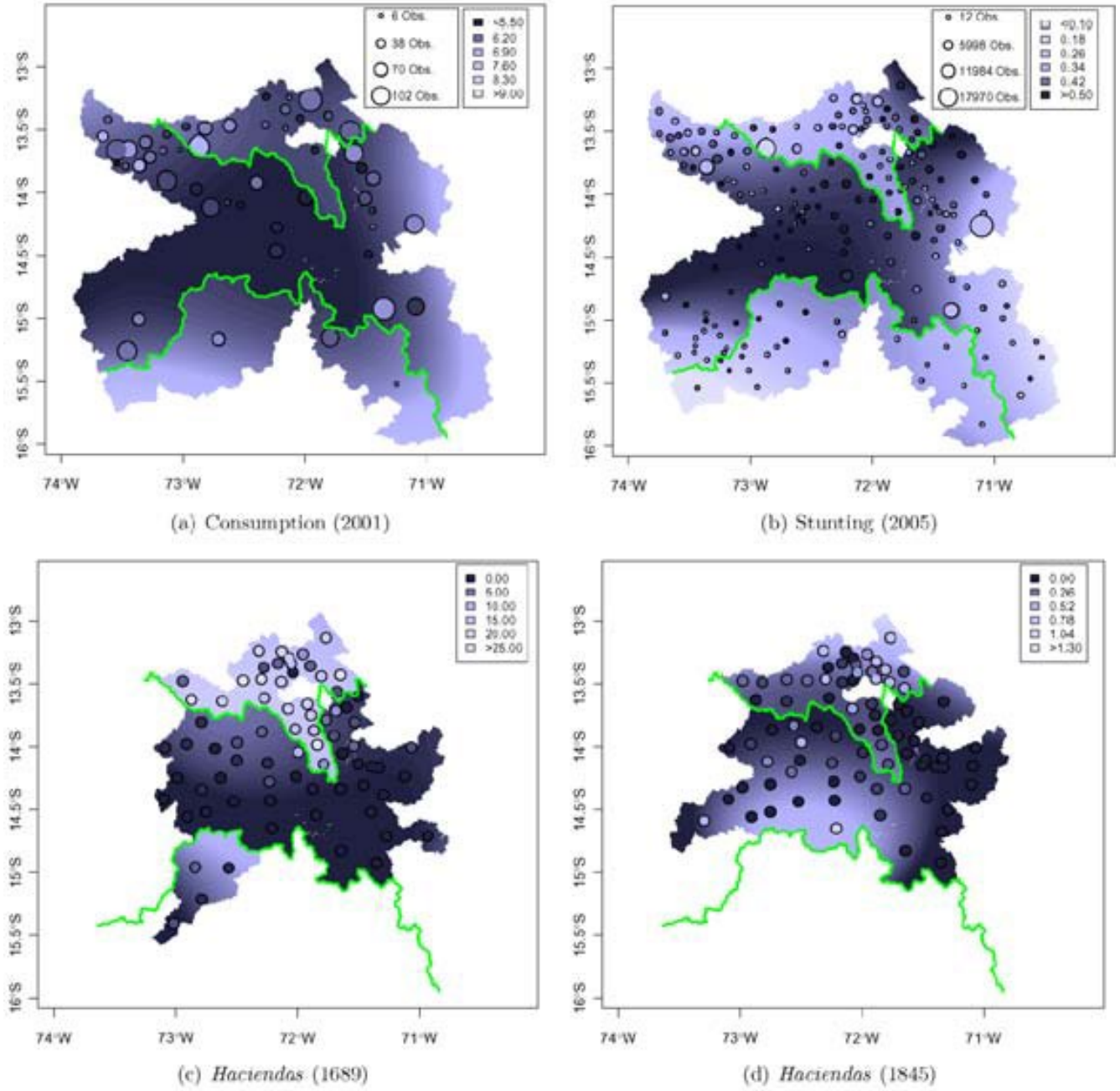
- Compares areas right inside with areas right outside mita zone
- Recall, mita ended in 1812

TABLE II

LIVING STANDARDS[a]

	Dependent Variable						
	Log Equiv. Household Consumption (2001)			Stunted Growth, Children 6–9 (2005)			
Sample Within:	<100 km of Bound. (1)	<75 km of Bound. (2)	<50 km of Bound. (3)	<100 km of Bound. (4)	<75 km of Bound. (5)	<50 km of Bound. (6)	Border District (7)
Panel A. Cubic Polynomial in Latitude and Longitude							
Mita	−0.284	−0.216	−0.331	0.070	0.084*	0.087*	0.114**
	(0.198)	(0.207)	(0.219)	(0.043)	(0.046)	(0.048)	(0.049)
R^2	0.060	0.060	0.069	0.051	0.020	0.017	0.050
Panel B. Cubic Polynomial in Distance to Potosí							
Mita	−0.337***	−0.307***	−0.329***	0.080***	0.078***	0.078***	0.063*
	(0.087)	(0.101)	(0.096)	(0.021)	(0.022)	(0.024)	(0.032)
R^2	0.046	0.036	0.047	0.049	0.017	0.013	0.047
Panel C. Cubic Polynomial in Distance to *Mita* Boundary							
Mita	−0.277***	−0.230**	−0.224**	0.073***	0.061***	0.064***	0.055*
	(0.078)	(0.089)	(0.092)	(0.023)	(0.022)	(0.023)	(0.030)
R^2	0.044	0.042	0.040	0.040	0.015	0.013	0.043
Geo. controls	yes	yes	yes	yes	yes	yes	yes
Boundary F.E.s	yes	yes	yes	yes	yes	yes	yes
Clusters	71	60	52	289	239	185	63
Observations	1478	1161	1013	158,848	115,761	100,446	37,421

[a]The unit of observation is the household in columns 1–3 and the individual in columns 4–7. Robust standard errors, adjusted for clustering by district, are in parentheses. The dependent variable is log equivalent household consumption (ENAHO (2001)) in columns 1–3, and a dummy equal to 1 if the child has stunted growth and equal to 0 otherwise in columns 4–7 (Ministro de Educación (2005a)). *Mita* is an indicator equal to 1 if the household's district contributed to the *mita* and equal to 0 otherwise (Saignes (1984), Amat y Juniet (1947, pp. 249, 284)). Panel A includes a cubic polynomial in the latitude and longitude of the observation's district capital, panel B includes a cubic polynomial in Euclidean distance from the observation's district capital to Potosí, and panel C includes a cubic polynomial in Euclidean distance to the nearest point on the *mita* boundary. All regressions include controls for elevation and slope, as well as boundary segment fixed effects (F.E.s). Columns 1–3 include demographic controls for the number of infants, children, and adults in the household. In columns 1 and 4, the sample includes observations whose district capitals are located within 100 km of the *mita* boundary, and this threshold is reduced to 75 and 50 km in the succeeding columns. Column 7 includes only observations whose districts border the *mita* boundary. 78% of the observations are in *mita* districts in column 1, 71% in column 2, 68% in column 3, 78% in column 4, 71% in column 5, 68% in column 6, and 58% in column 7. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%.



(a) Consumption (2001)

(b) Stunting (2005)

(c) *Haciendas* (1689)

(d) *Haciendas* (1845)

FIGURE 2.—Plots of various outcomes against longitude and latitude. See the text for a detailed description.

Peru's Mining Mita

- Dell argues that long-term effects of mita come through land tenure and public goods
- Haciendas – rural estates with attached labor force – primarily outside mita
- Colonial policy encouraged communal land tenure inside mita
- Security of land rights better outside mita area after mita ended
- Haciendas elite pushed for public goods such as roads

Colonization as a Natural Experiment

- Starting in 15th century Europeans conquered much of the rest of the world
- Imposed new institutions
- Imposed different institutions in different places
- Acemoglu, Johnson, Robinson (2001, 2002) argue that this can be viewed as a natural experiment to assess the effect of institutions on prosperity

Reversal of Fortunes

- In 1500:
  - Mughals in India, Aztecs and Incas in Americas among richest civilizations (outside Europe)
  - North-East U.S., New Zealand, Australia much less developed
- Today:
  - Lands of Mughals, Aztecs and Incas among poorer societies
  - U.S., New Zealand, Australia among richest

Reversal of Fortunes

- Systematic phenomenon?
- How to measure income in 1500?
- Urbanization: Only societies with a certain level of development can sustain large urban centers

- Puzzling from perspective of geography story

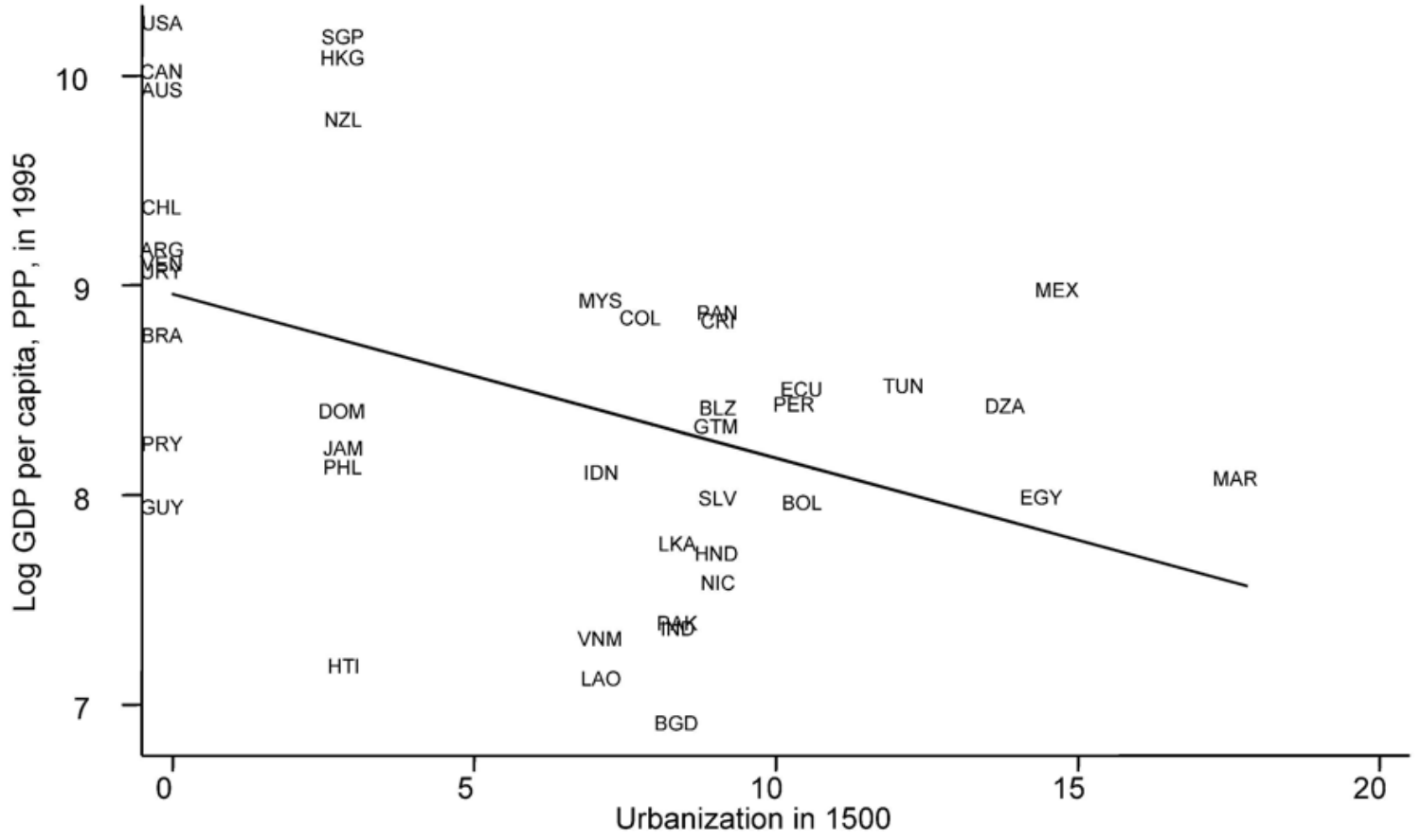


Figure 5. Urbanization in 1500 and log GDP per capita in 1995, among former European colonies.

Acemoglu, Johnson, Robinson (2005)

No Reversal For Non-Colonies

- Countries that were not colonized by Europeans did not see reversal of fortunes

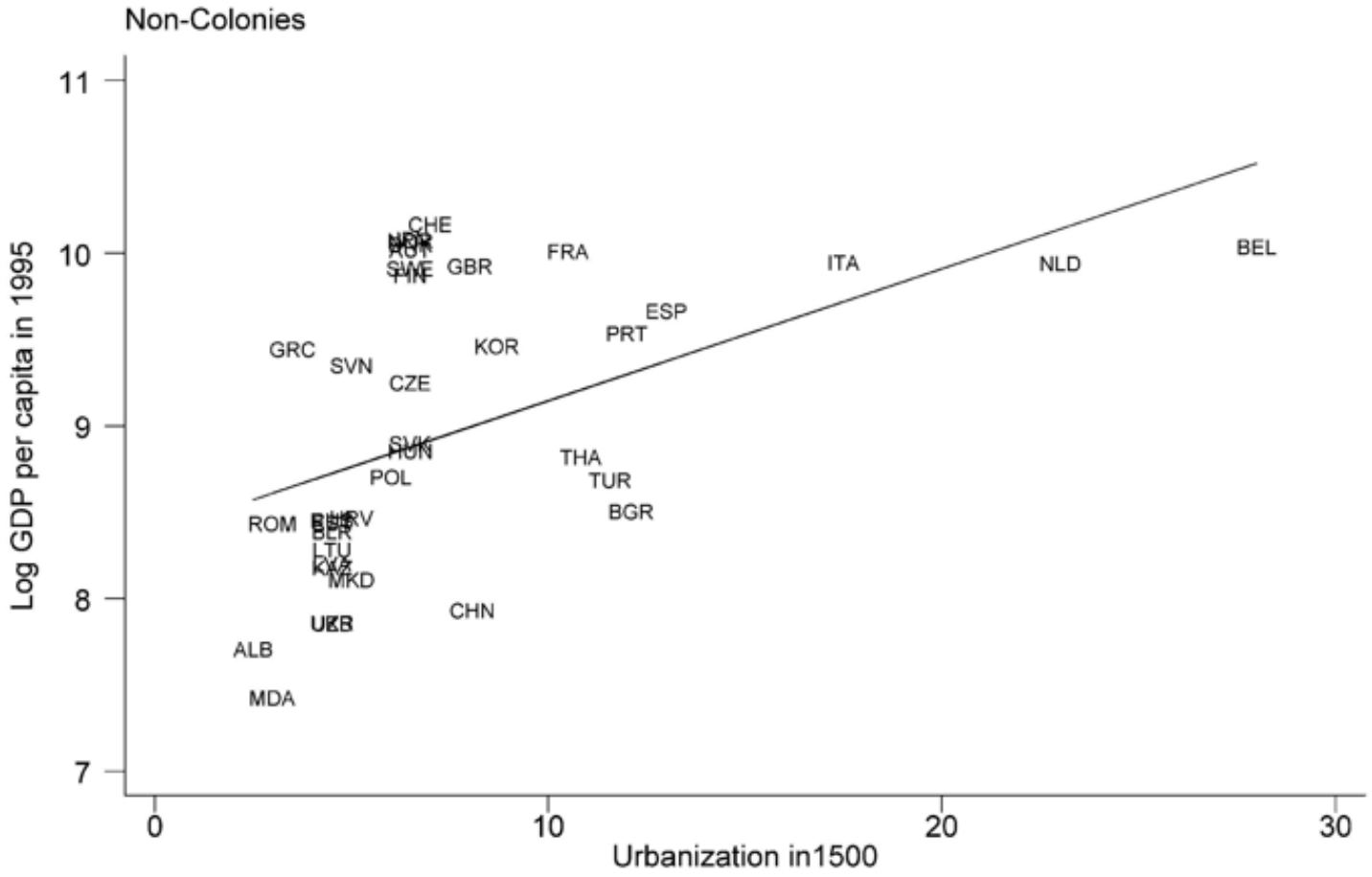


Figure 9. Urbanization in 1500 and log GDP per capita in 1995, among non-colonies.

Acemoglu, Johnson, Robinson (2005)

Timing of Reversal

- High urbanization regions faced large decline after 1500 (exploitation)
- Low urbanization regions saw gradual rise that took off in 19th century
- Only at time of industrialization did low urbanization regions really take off

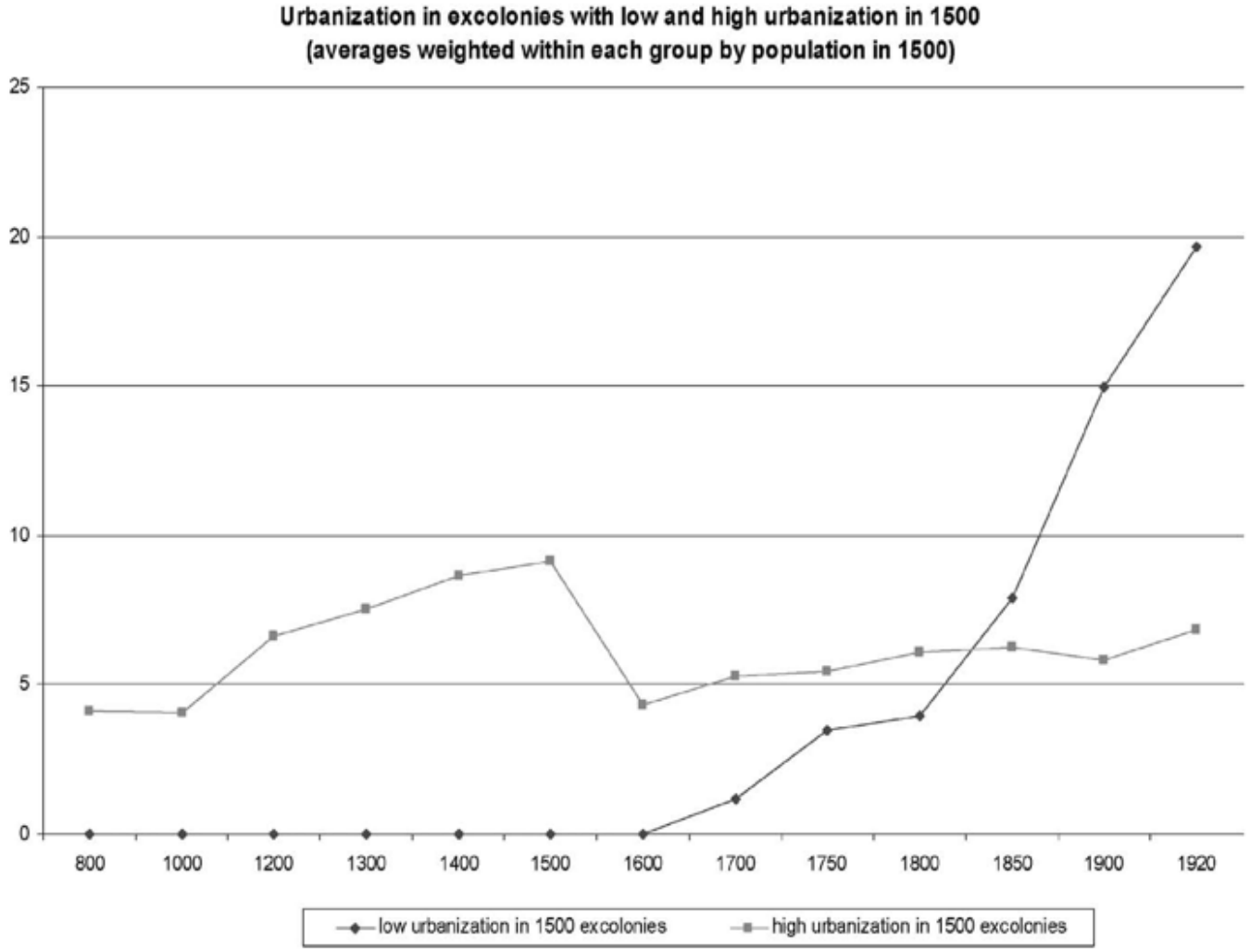


Figure 10. Evolution of urbanization among former European colonies.

Acemoglu, Johnson, Robinson (2005)

Institutions and Reversal

- AJR argue that Europeans set up “worse” (more extractive) institutions in regions with higher urbanization
- Institutions very persistent
- This eventually caused reversal of fortunes

- Why did Europeans set up worse institutions in the tropics?

Why Different Institutions?

1. Where there was wealth to steal it had appeal to set up institutions that facilitated “extracting resources”
   - Gold, silver, sugar, people to exploit.

   Where there was little wealth and few people it made less sense to try to “extract resources”.

Why Different Institutions?

2. Different disease environment
   - Europeans have poor immunity against tropical diseases
   - High mortality of European settlers in certain areas meant low levels of settlement in those areas
   - Where Europeans didn't settle, they set up worse institutions
   - Where they did settle, they set up better institutions
   - Institutions persisted
   - Disease environment 200 years back affects outcomes today through institutions

AJR's Theory

(potential) settler mortality $\Rightarrow$ settlements

$\Rightarrow$ early institutions $\Rightarrow$ current institutions

$\Rightarrow$ current performance.

Source: Acemoglu, Johnson, Robinson (2001)

Settler Mortality as an Instrument

- AJR propose to use settler mortality as an instrument for current institutions
- Two conditions must hold for this to be a valid instrument
  - Relevance: Settler mortality must be correlated with current institutions. (It is. See next slide)
  - Exogeneity: Settler mortality cannot be correlated with any other cause of current prosperity (i.e., it should only affect current prosperity thought current institutions)
- Threat to exogeneity?

Settler Mortality and Current Institutions

- Settler mortality is correlated with current institutions
- Places with low settler mortality have better current institutions (as measured by protection against risk of expropriation)

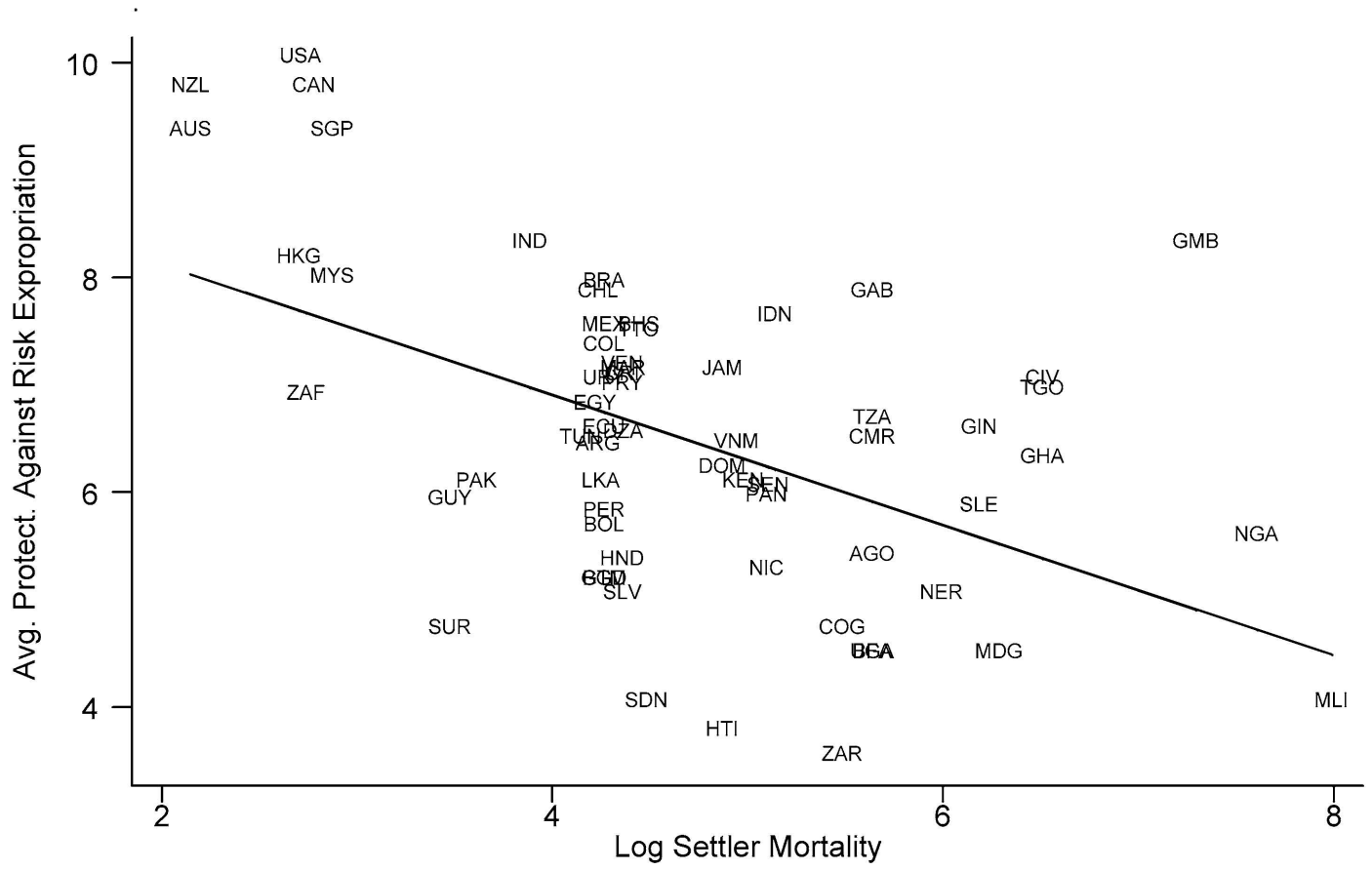


Figure 14. Log mortality of potential European settlers and average protection against risk of expropriation 1985–95.

Settler Mortality and Current Prosperity

- Settler mortality is strongly related to current prosperity
- If exogeneity holds, this correlation is only due to affect on current institutions
- In this case, it provides evidence for institutions affecting prosperity
- Effect is very large (can explain bulk of income differences)

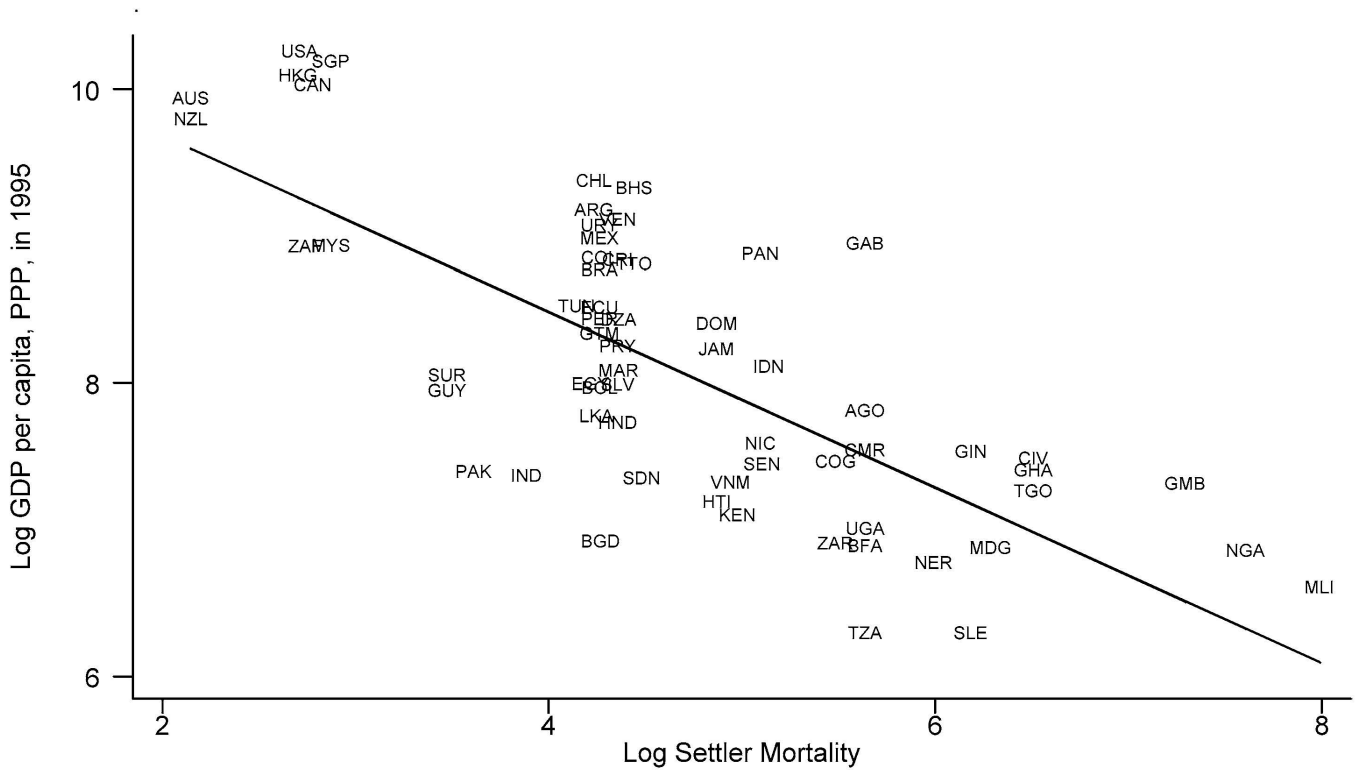
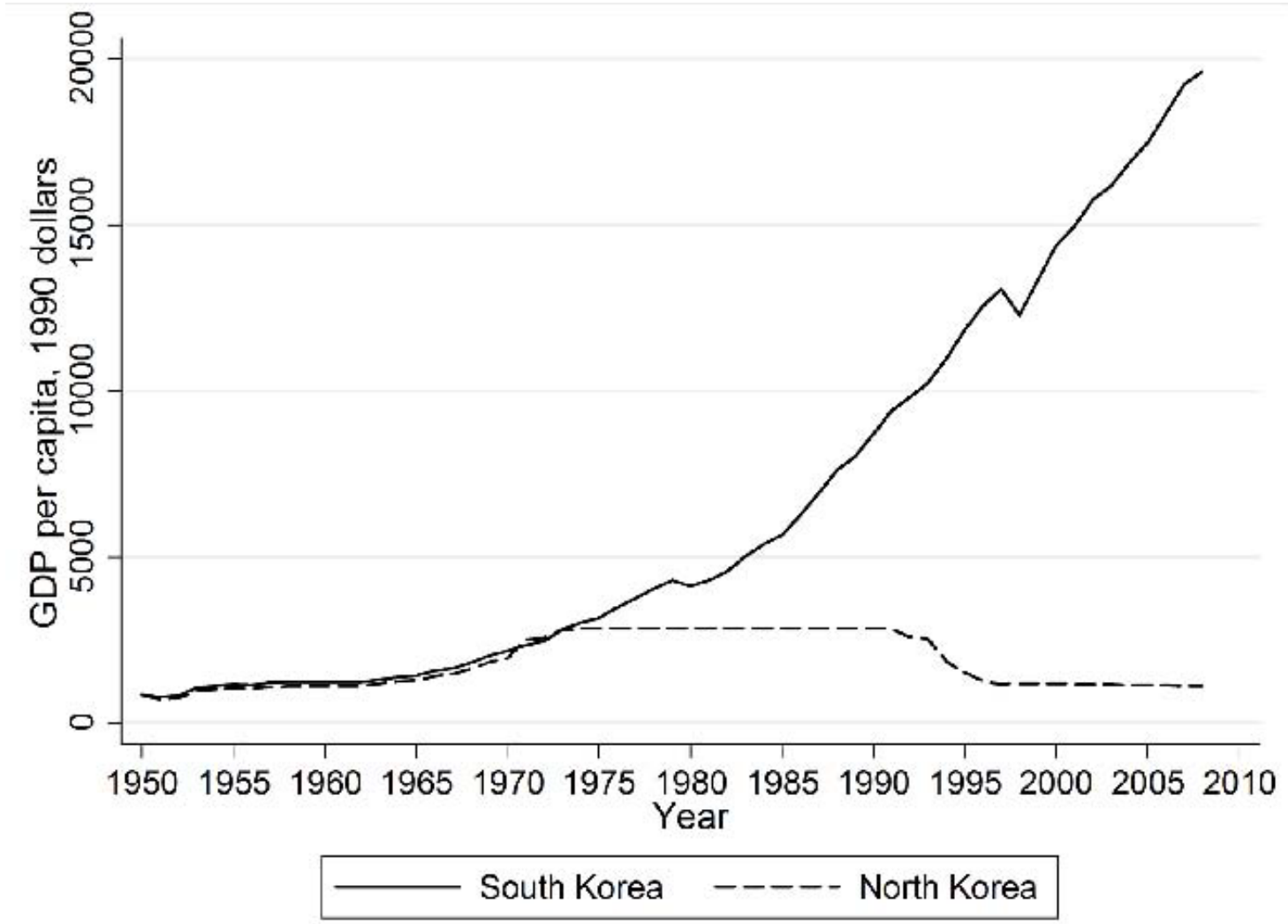


Figure 15. Log mortality of potential European settlers and log GDP per capita in 1995.

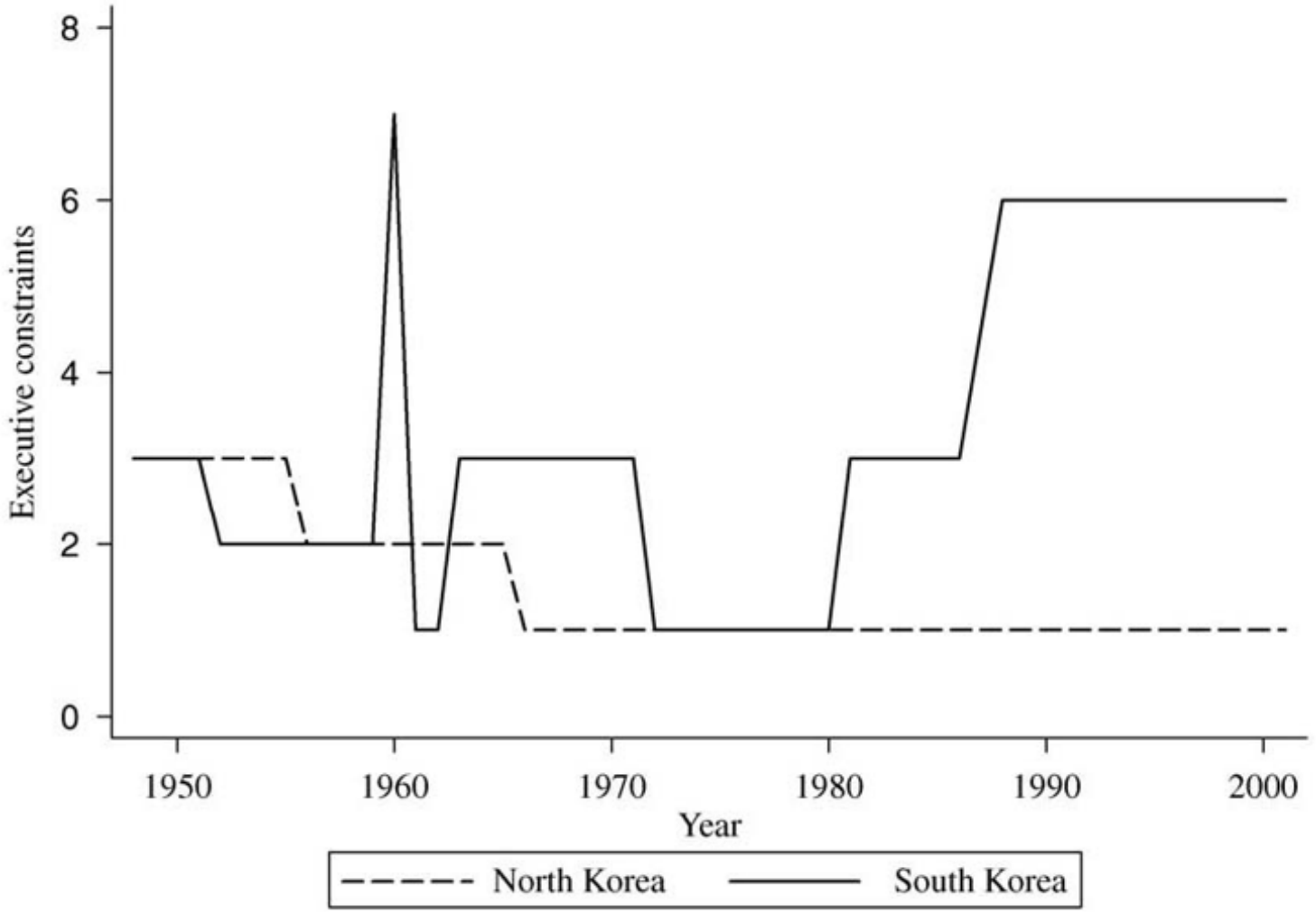
Institutions or Just Luck?

- North vs. South Korea often used as an example of institutions mattering
- But how convincing is this example?
- Perhaps difference is largely luck in the form of leaders of different quality



Did South Korea Have Better Institutions?

- Not clear South Korea had better institutions
- They were a dictatorship just like North Korea
- But their dictator (Park Chung-hee, 1961-1979) chose different policies than North Korea's (Kim Il Sung, 1948-1994)



Do Leaders Matter for Growth?

Differing views:

- Tolstoy: Historical figures mere ex post justifications for events out of any individual's influence
- Marx: "materialist dialectic". Social and economic forces trump individuals
- John Keegan: The political history of the twentieth century can be found in the biographies of six men: Lenin, Stalin, Hitler, Mao, Roosevelt and Churchill.

Do Leaders Matter for Growth?

- Claim: National leaders cause changes in growth in the countries they govern.
- How can we bring evidence to bear on this causal question?
  - Look at whether changes in leaders are systematically associated with changes in growth?
  - But leadership transitions are not random
  - Leader my be ousted because growth is bad (reverse causality)

Do Leaders Matter for Growth?

- We need to find a natural experiment
- Are there any leadership transitions that are random from the perspective of growth?
- Jones and Olken (2005):
  - Look at leadership transitions due to death of leaders while in office
  - Deaths from natural causes and accidents (exclude assassinations)
  - In these cases, the timing of the transition is random

TABLE I
How Leaders Leave Power

130 Countries

All Leaders from 1945 or National Independence Date through 2000

Number of Observations, by Type

Lost election	Term limits	Voluntary retirement	Deposed	Death[a]	Other	Total
310	178	131	222	105	225	1184[b]

Assassination	Natural	Accidental	
28	65	12	105

Heart disease	Cancer	Stroke	Other disease	Surgical complications	Other	Air crash	Other	
29	12	6	6	3	9	8	4	77[c]

a. There are 21 further cases (not included here) where leaders are killed during a coup.

b. There are 1294 distinct terms in which leaders are in power in the data set, but only 1184 counted in this table, as we do not witness the exit of leaders who are still in power at the end of the year 2000.

c. There are 77 cases of leaders who die in office by natural causes or accidents, but only 57 who die during periods where there are available growth data before and after the leader's death.

Source: Jones and Olken (2005)

How Do We Measure Effect?

- For deaths of leaders: Calculate difference in growth in T years before death and T years after death
- They want to know if this change is unusual
- So, they calculate same statistic for all years (i.e., change in growth T years before and after year t)
- Ask: Is change when leaders die unusually large?

A Few Dramatic Examples

- China: Mao (Great Leap Forward, Cultural Revolution)
- Mozambique: Samora Machel (Communist, nationalized all private land, Portuguese fled)
- Guinea: Sekou Toure (totalitarian violent purges)
- Iran: Ayatollah Khomeini (opposed peace in Iran-Iraq war)

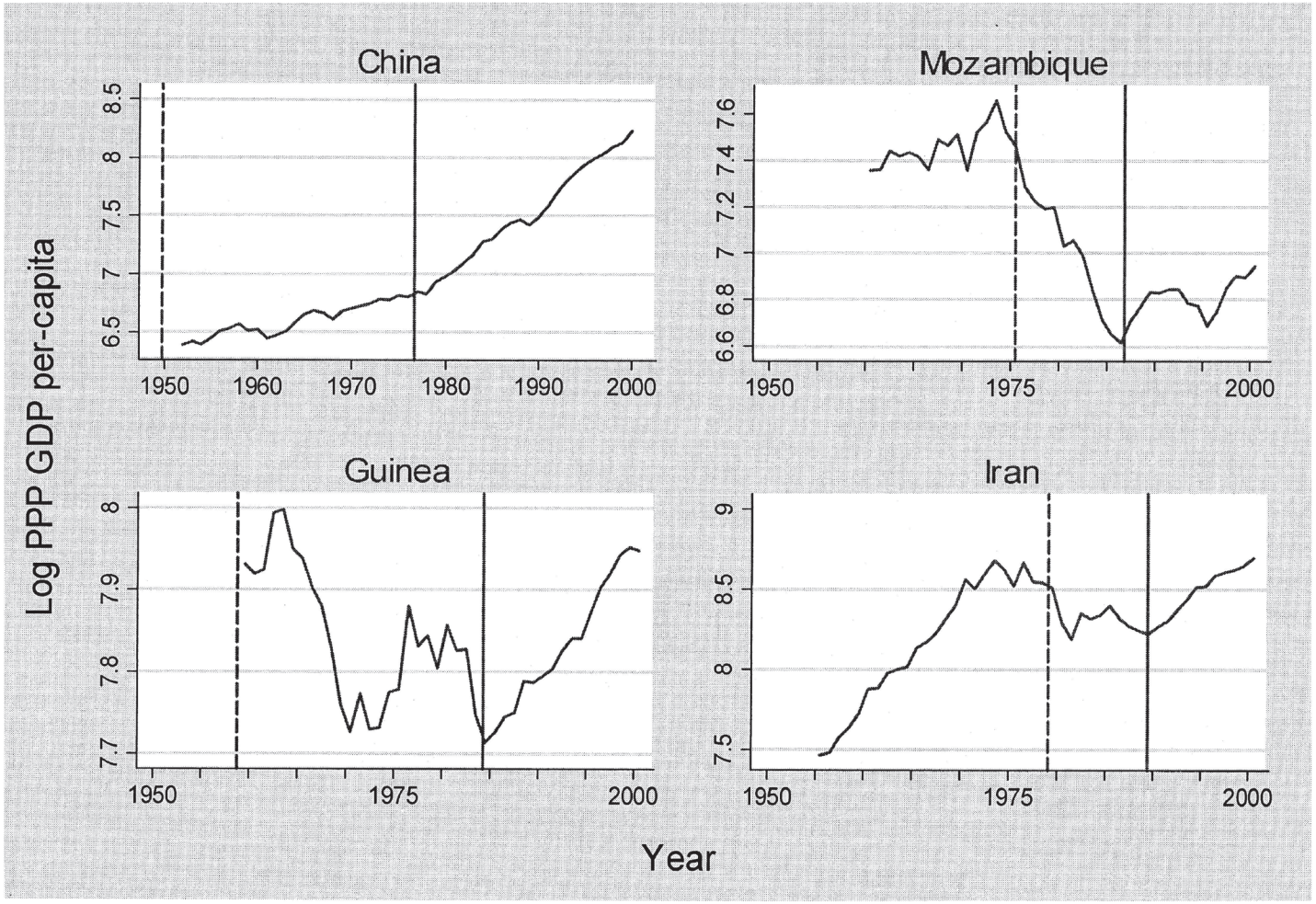


FIGURE I
Growth and Leader Deaths

Systematic Results

- Variance of $Post - Pre$ is 31% higher for leader death years than for other years.
- Difference is statistically significant
- With a few more assumption:
  - A one standard deviation increase in leader quality increases growth rate by 1.5% per year
- Effect only exists for autocratic regimes. Not for democracies. Larger for countries with fewer constraints on executive power