

Introduction to Economic Growth: Why are some countries poorer than others?

Alexander Yarkin

Brown University, Summer School 2021

Lecture 7: The Role of Geography

Three big questions that this lecture will help to answer

Question 1 What specific geographic features are especially important for development? Is it disease environment? Land productivity? Isolation?

Question 2 What are direct effect of geography on development, and what the indirect effects - e.g., via institutions and culture?

Question 3 How persistent is prosperity? Since geography is persistent, does it mean that prosperity, institutions, etc. are predetermined?

Summary of how we look at the effects of geography

- ① Biogeographical characteristics that led to the differential timing of the Neolithic Revolution (based on famous Jared Diamond's theory)
- ② Geographical characteristics that have directly affected contemporary prosperity (disease environment, temperature, isolation, natural resources, etc. See Gallup, Sachs, and Mellinger (1999))
- ③ Geographical characteristics that have indirectly affected contemporary prosperity via:
 - the effects of geography on institutions (such as the rule of law)
 - the effects of geography on the formation of certain cultural and behavioral norms (such as gender roles, forward-looking behavior, etc.)
- ④ Is it all pre-determined because of geography? The 'Reversal of Fortune' argument.

Today's lecture

- ① Prosperity in the year 1500, and Jared Diamond's hypothesis
- ② Direct effects of geographic characteristics on contemporary development
 - Diseases
 - Isolation
- ③ Indirect effects of geography
 - Geography and Institutions
 - Geography shaping Preferences and Culture
- ④ Reversal of Fortune

Jared Diamond's hypothesis

Earlier transition from hunter-gatherer tribes to agricultural communities is key for early development success:

- Higher productivity and population density → emergence of non-food-producing class → knowledge creation, science, written language, etc.
- Technological head start and higher population numbers leads to
 - urbanization
 - nation states
 - colonization of less developed societies
- But why had certain societies transitioned to agriculture earlier?
- Geography! Namely, availability of domesticable plants and animals + orientation of Eurasia from East to West (rather than from North to South)

Jared Diamond's hypothesis

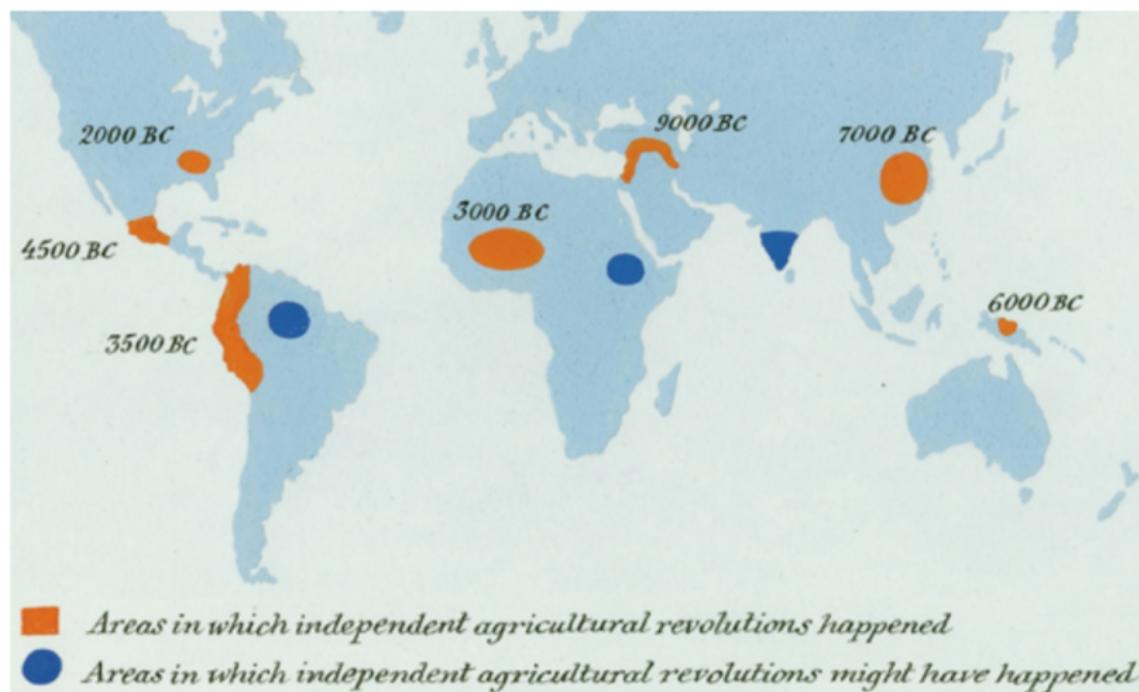


Figure 1: Independent origins of the Neolithic. Source: vivdmaps.com

Jared Diamond's hypothesis

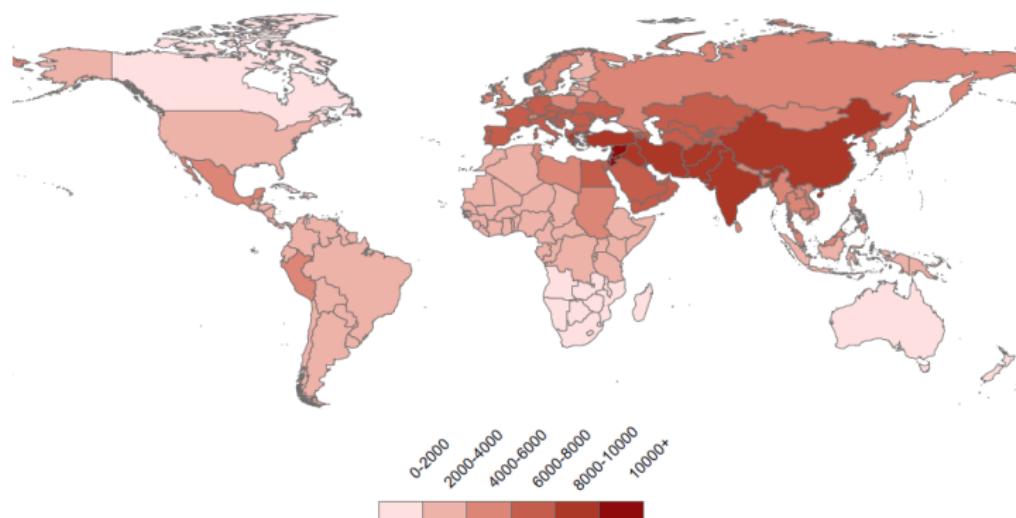


Figure 2: Onset of the Neolithic Revolution across the Globe. Source: Oded Galor's Lectures

Jared Diamond's hypothesis

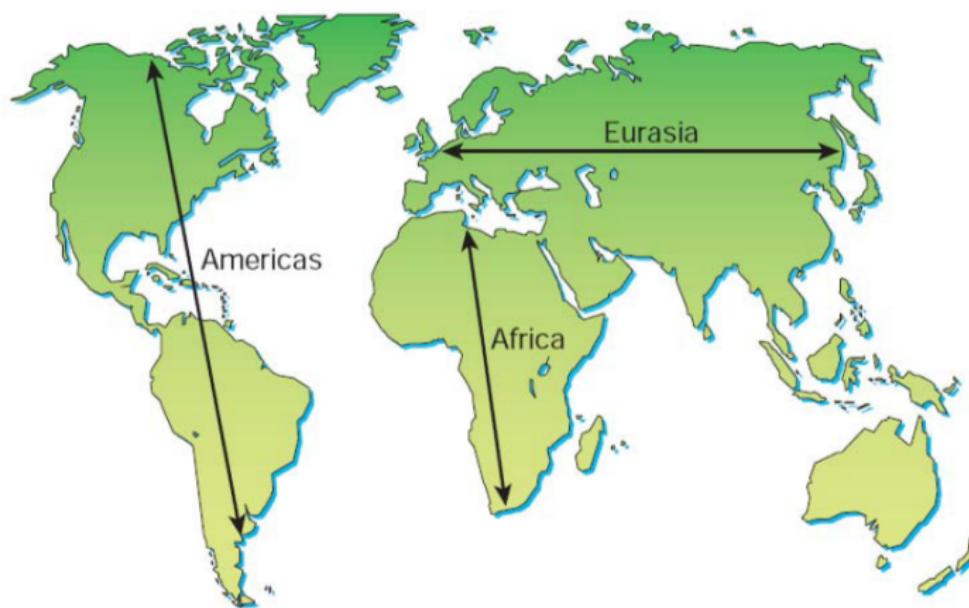


Figure 3: Orientation of continents. Source: Diamond (2002)

Domesticable plants

ORIGINS AND PRIMARY REGIONS OF DIVERSITY OF AGRICULTURAL CROPS

Khoury OK, Achigan-Dzaad A, Barreiro-Llave C, Guarino L, Flores-Palacios X, Engels JMM, Wiersma JH, Dierpenshoff H, Schlelo S, Ramírez-Villagran J, Castañeda-Alvarez NP, Fowler C, Jaramil A, Rineberg LH, and Strak PC (2016). Origins of food crops connect countries worldwide. Proc. R. Soc. B 283: 20160792. DOI 10.1098/rspb.2016.0792.



Figure 4: Domesticable crops. Source: vividmaps.com

Domesticable animals

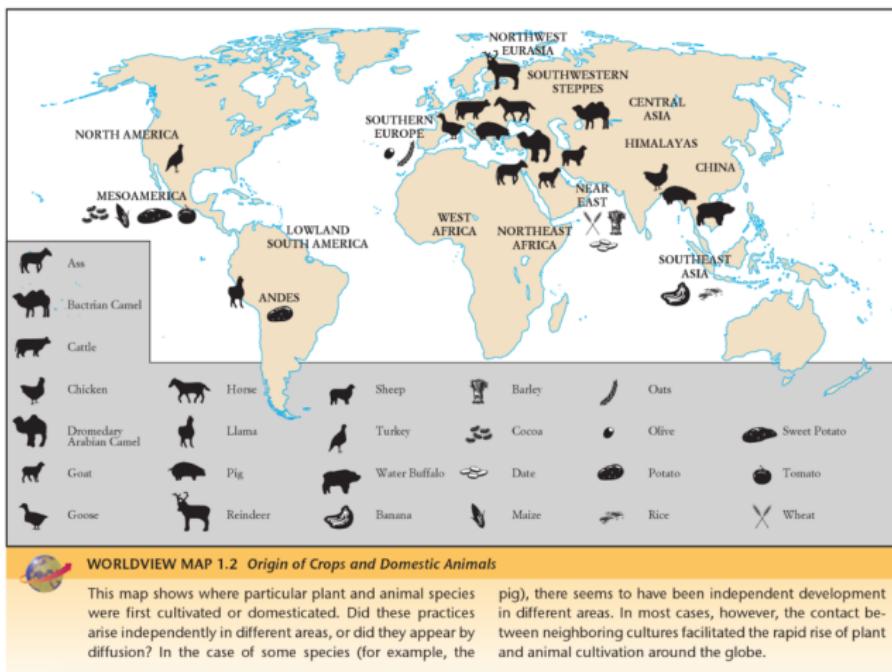


Figure 5: Domesticable animals. Source: vividmaps.com

Jared Diamond's hypothesis: works very well until approx. 1500CE

	Technology Level 1000BCE-1500CE					
	1000BCE		1CE		1500CE	
	(1)	(2)	(3)	(4)	(5)	(6)
Years Since Neolithic Revolution	0.72*** (0.06)	0.47*** (0.12)	0.56*** (0.06)	0.28** (0.12)	0.74*** (0.06)	0.34*** (0.10)
Continental FE	No	Yes	No	Yes	No	Yes
Additional Geographical Controls	No	Yes	No	Yes	No	Yes
Adjusted- R^2	0.51	0.60	0.31	0.63	0.55	0.82
Observations	112	111	134	133	113	112

Notes: Standardized coefficients from an Ordinary Least Squares (OLS) regression. Heteroskedasticity robust standard error estimates are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

Figure 6: The effects of Years since Neolithic on Historical Technology Levels.
Source: Oded Galor's Lectures

Jared Diamond's hypothesis: does not work for today

	Technology Level 2000CE					
	(1)	(2)	(3)	(4)	(5)	(6)
Years Since Neolithic Revolution	0.15*	-0.09	-0.09			
	(0.09)	(0.08)	(0.11)			
Years Since Neolithic Revolution (Ancestors)				0.32***	0.09	0.09
				(0.07)	(0.07)	(0.10)
Continental FE	No	No	Yes	No	No	Yes
Additional Geographical Controls	No	Yes	Yes	No	Yes	Yes
Adjusted- R^2	0.02	0.55	0.59	0.10	0.55	0.59
Observations	132	131	131	132	131	131

Figure 7: The effects of Years since Neolithic on Current Technology Levels.
 Source: Oded Galor's Lectures

Diamond's hypothesis

Thus, Jared Diamond's hypothesis works very well for up until approx. 1500CE.

- It helps to understand why Europe colonized the Americas and Africa, and not the other way around
- And why, for example, China was among the most developed regions in the pre-modern period
- However, it also shows that geography isn't destiny: something has changed after 1500, and we don't see the effects of early Neolithic transition matter today
- We will see later on why this 'reversal' happened

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The role of disease environment: burden of disease

One of the most clear and easy ways to measure the overall burden of disease environment is with the DALY: Disability Adjusted Life Years (1 DALY is 1 lost year of healthy life)

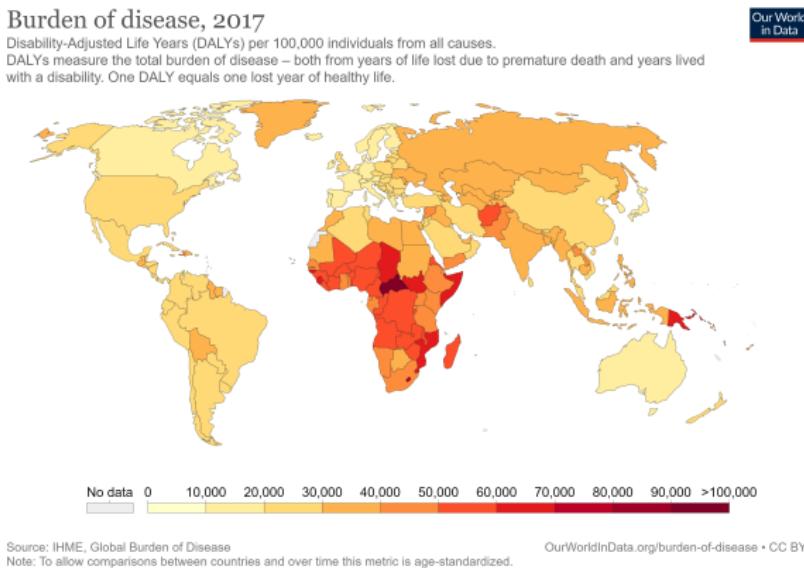


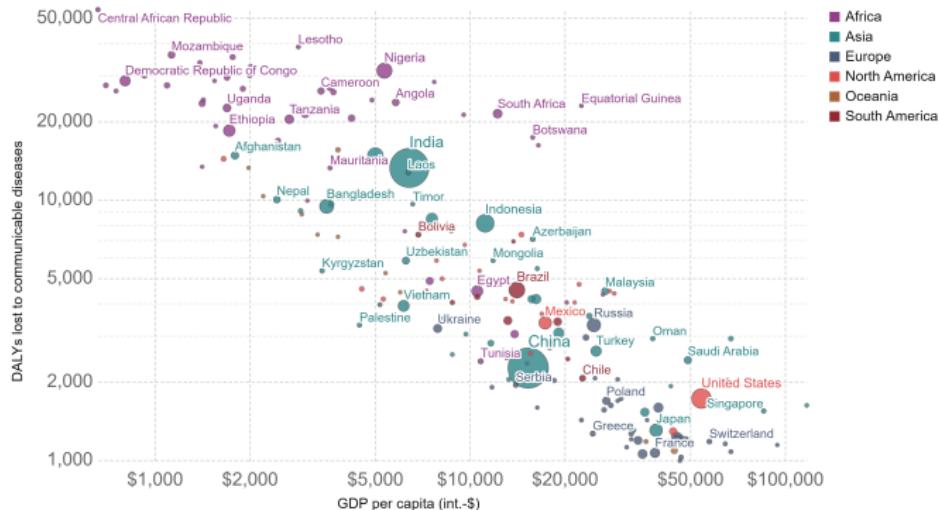
Figure 8: DALYs across the world, all causes. Source: ourworldindata.org

The role of disease environment: burden of disease

Disease burden due to communicable diseases vs. GDP per capita, 2017

Disease burden to communicable, maternal, neonatal and nutritional diseases, measured in DALYs (Disability-Adjusted Life Years) per 100,000 individuals versus gross domestic product (GDP) per capita, measured in 2011 International-\$.

Our World
in Data



Source: IHME, Global Burden of Disease; World Bank – WDI

OurWorldInData.org/burden-of-disease/ • CC BY

Figure 9: DALYs from communicable diseases, and GDPpc. Source: ourworldindata.org

The role of disease environment: malaria

"Where malaria prospers most, human societies have prospered least." Sachs and Malaney (2002)

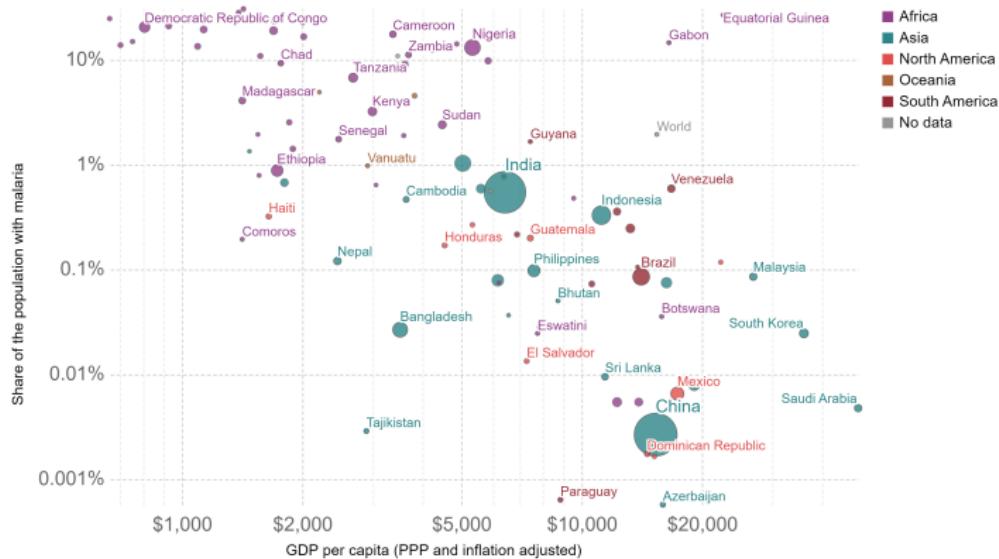
- Among many diseases causing great suffering and underdevelopment, malaria clearly stands out.
- Malaria has a massive death toll each year, and, importantly, mostly kills young children Malaria death toll
- If malaria does not kill, it leads to a long-term reduction in physical and mental capacity
- Malaria is mostly prevalent in SSA and South Asia Malaria incidence rates

The role of disease environment: malaria and GDPpc

Our World
in Data

Malaria prevalence vs GDP per capita, 2017

Malaria prevalence is the share of the population with malaria at any given time. This rate is age-standardized assuming a constant population structure over time and between countries.



Source: IHME, Global Burden of Disease; World Bank

OurWorldInData.org/malaria/ • CC BY

Figure 10: Malaria prevalence and GDPpc. Source: ourworldindata.org

The role of disease environment: effects of malaria eradication

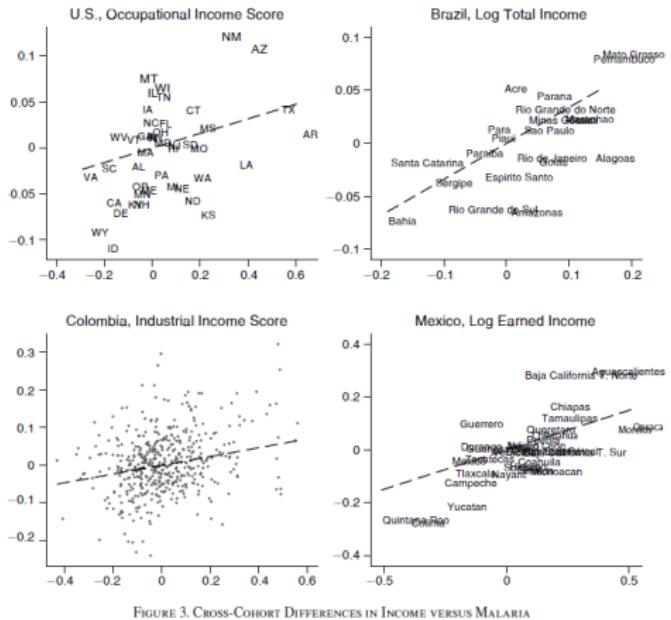


FIGURE 3. CROSS-COHORT DIFFERENCES IN INCOME VERSUS MALARIA

Figure 11: Malaria eradication and various development outcomes in four countries. Source: Bleakley (2010)

The role of disease environment: tse-tse flies (sleeping sickness)

Another important disease is 'sleeping sickness' (African Trypanosomiasis).

- It kills domesticated animals, and may cause severe weakness, sleepiness, and even death in humans
- Alsan (2015) shows how the climatic suitability for the TseTse flies (who transmit the parasite) affects
 - Animal domestication
 - Population density
 - Political centralization
 - And other important development outcomes
- Hampers development up till today

The role of disease environment: tse-tse flies (sleeping sickness)

Panel A. TseTse suitability index (1871)

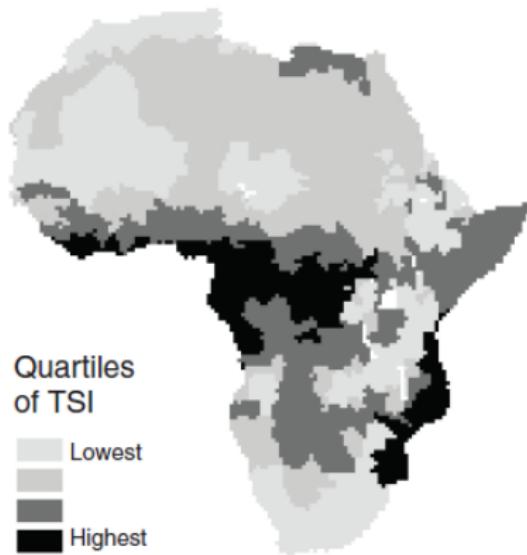


Figure 12: TseTse prevalence in Africa. Source: Alsan (2015)

The role of disease environment: TseTse flies (sleeping sickness)

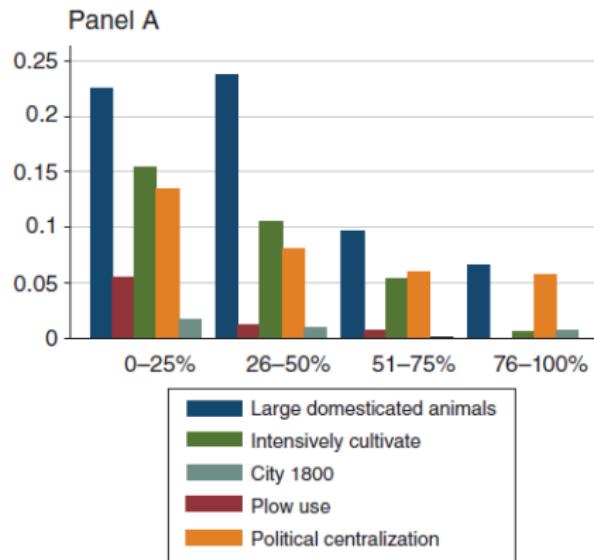


Figure 13: TseTse prevalence and historical development outcomes. Source: Alsan (2015)

The role of disease environment: summary

Unfavorable disease environments affects growth and prosperity in several harmful ways:

- Most simple: direct effects on productivity
Basically, "More disease → lower health and productivity → lower growth"
- Lower human capital accumulation and lower savings rate (Bloom et al. (2003), also a review in Bleakley (2010))
"More disease → lower expected returns on investment (especially in human capital) → lower growth"
- Lower population density (hence, slower development in the Malthusian Era), slower adoption of domesticable animals and other technologies
- Indirect effects on institutions and culture (more on that later on)

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The role of distance and isolation

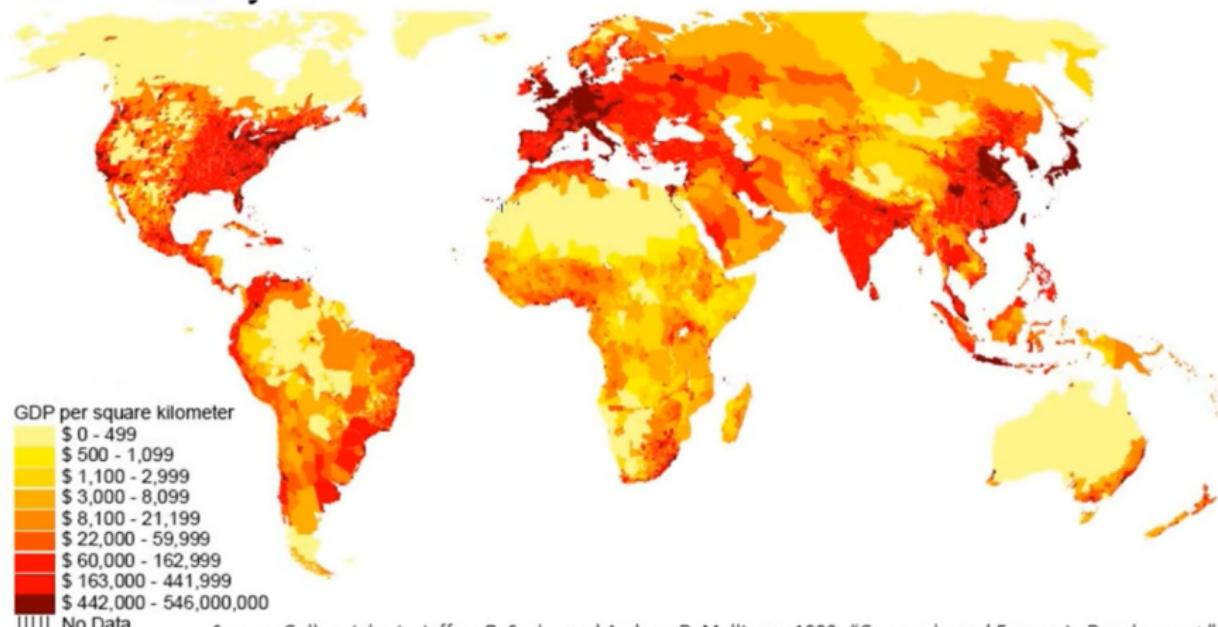


Figure 14: Smithian argument on isolation, trade, and growth. Source: Alex Tabarrok and Tyler Cowen, MRU

The role of distance and isolation: landlocked countries

By 'isolation' we mean the extent to which a country (or a subnational region) is connected to other countries/regions.

The basic idea behind the effect of isolation is that (following our discussion of the effects of a market size in Lecture 3) better connectivity means larger markets

- which boosts trade
- incentivizes technological change
- leads to specialization
- and promotes growth



Figure 15: Smithian argument on isolation, trade, and growth. Source: Alex Tabarrok and Tyler Cowen, MRU

The role of distance and isolation: foreign market access and GDPpc

Figure 1.
GDP per capita and FMA

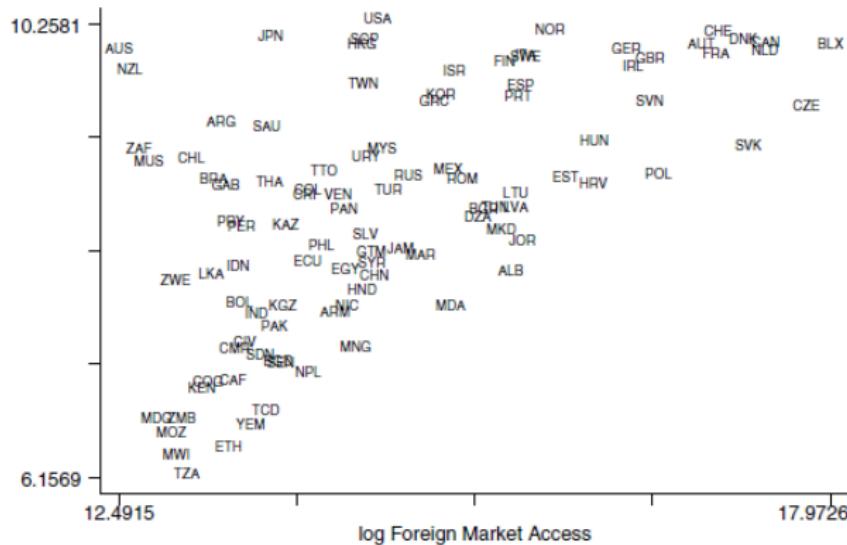


Figure 16: Foreign Market Access and GDPpc. Source: Redding and Venables (2002).

The role of distance and isolation: landlocked countries vs. non-landlocked

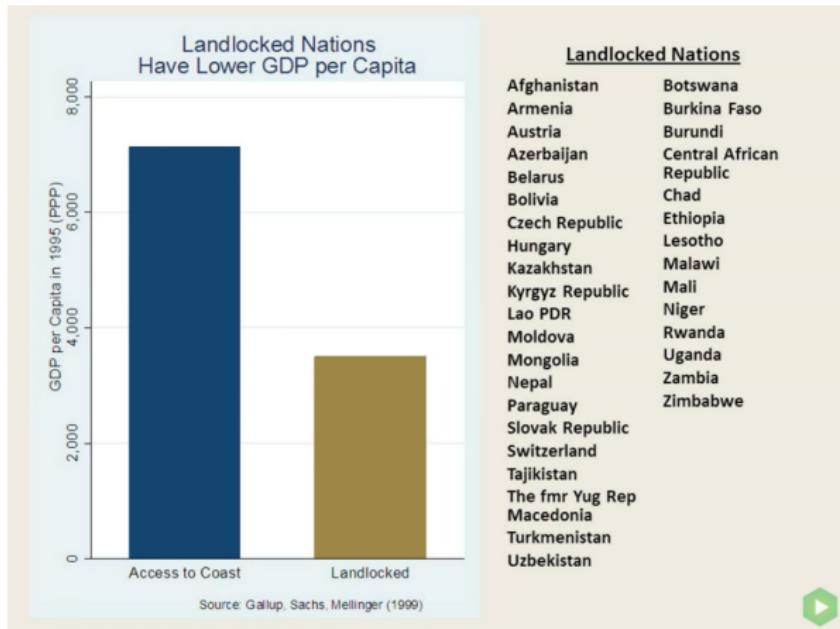


Figure 17: Average GDPpc in landlocked vs. non-landlocked countries. Source: Alex Tabarrok and Tyler Cowen, MRU

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AJR (2001): Tropical diseases and colonial institutions

We have already seen an amazing research by Acemoglu, Johnson and Robinson (2001), showing how

- historical disease environment (settler mortality) has affected institutions that colonizers had installed in their colonies.
- historical institutions have persisted, to a certain extent, till nowadays.
- and how this establishes a causal positive effect of good institutions on growth.

AJR (2001): Tropical diseases and colonial institutions

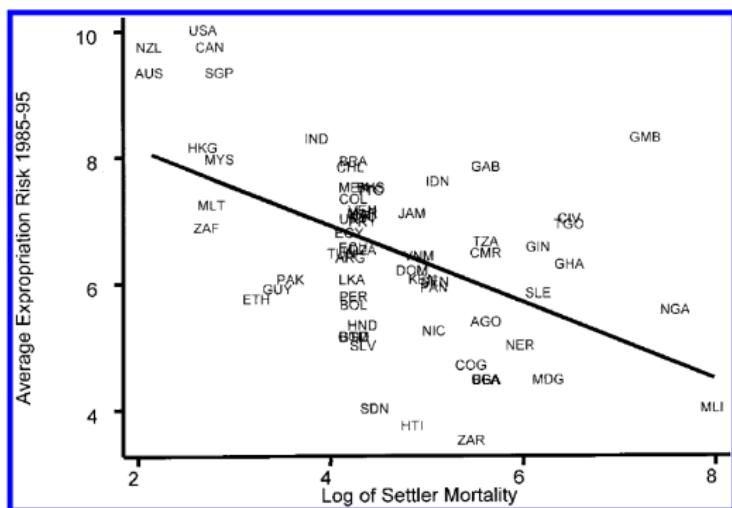


FIGURE 3. FIRST-STAGE RELATIONSHIP BETWEEN SETTLER MORTALITY AND EXPROPRIATION RISK

Figure 18: Average Protection against expropriation and historical settler mortality. Source: Acemoglu, Johnson, Robinson (2001).

Engerman and Sokoloff (2000): Natural resources, Inequality, and Institutions

In the Americas (both South and North parts), certain soils and climates were especially conducive for large labor-intensive plantations, such as sugar and coffee, but also mineral resources (e.g., in Mexico and Peru).

In such places, local elites enriched themselves, mostly relying on slave labor, and constrained education and mobility of the remaining population, thereby leading to enormous inequality of economic resources and political power.

This, in turn, prevented these societies from adopting many of the key pro-growth institutions: public schooling, rule of law, and democracy.

Geography and Inequality: then and now

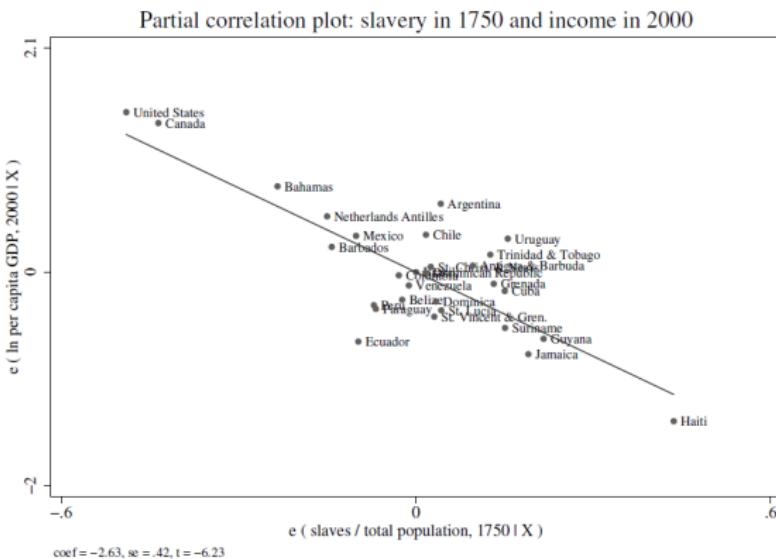


Figure 2: Partial correlation plot showing the relationships between the proportion of slaves in the population in 1750 S_i/L_i and the natural log of per capita GDP in 2000 $\ln y_i$.

Figure 19: Slave ownership in the Past and Development today in the Americas.
 Source: Nunn (2007)

Natural and Inequality: then and now

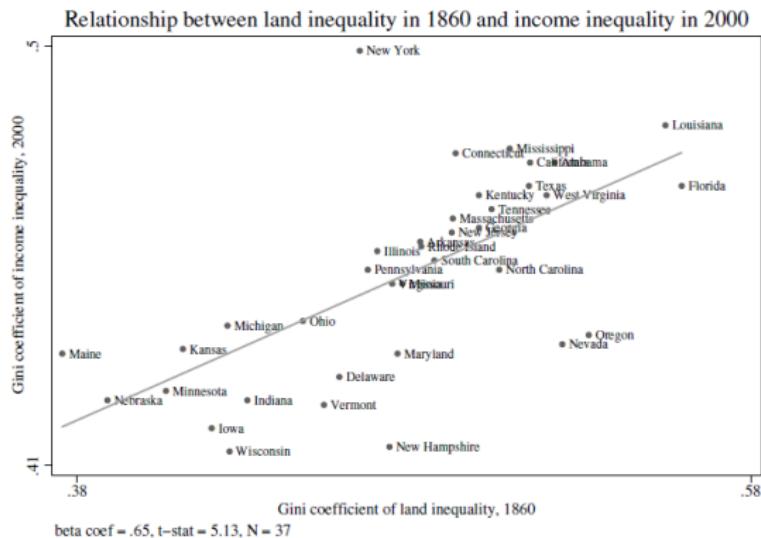


Figure 10: Bivariate plot showing the relationship between the Gini coefficient of land inequality in 1860 and the Gini coefficient of income inequality in 2000.

Figure 20: Historical inequality, and today's inequality in the US. Source: Nunn (2007)

Natural resource curse

One of the crucial effects of contemporary (and past) resource abundance is that it can stifle growth

- by making institutions worse (lower democracy, more rent-seeking, etc.), see Ross (2001) among others
- or because institutions are already worse, and poor institutions, together with natural resources, produce conflict, rent-seeking (see Mehlum et al. (2006) among others).

Natural resource curse: evidence from Mehlum et al. (2006)

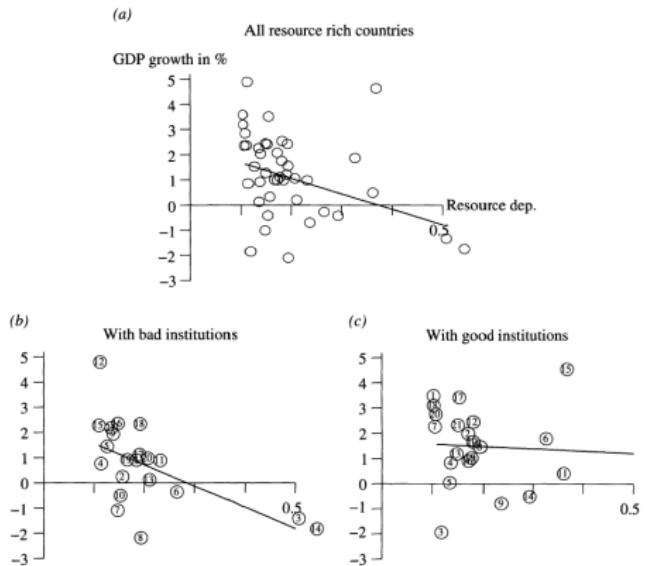


Fig. 1. Resources and Institutions (a) all resource rich countries (b) with bad institutions
(c) with good institutions

Figure 21: The effect of natural resources on growth: the role of institutions.
Source: Mehlum et al. (2006)

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Alesina et al. (2013) On the Origins of Gender Roles: Women and the Plough

Alesina and co-authors examine the hypothesis put forth by Ester Boserup (1970): that forms of traditional agriculture affected the formation of gender roles

- Where land was conducive for the use of plough (for growing wheat, barley, rye, and a few other crops), plough is more likely to be used (exogenous reason for the use of plough).
- Plough required significant upper body strength (to pull the plough or to control the animal that pulls it), so men specialized in working in the field, women - in the home.
- Emergence of gender-based specialization back in historical, traditional societies.
- Even today, descendants of societies practicing plough agriculture report less egalitarian gender roles, lower female LFP, and lower female participation in politics.

Alesina et al. (2013) On the Origins of Gender Roles: Women and the Plough

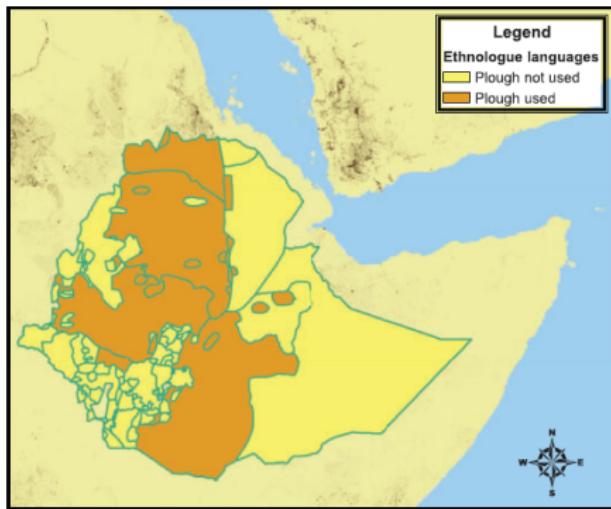


FIGURE I
Populations, Language Groups, and Historical Plough Use within Ethiopia

Figure 22: Example of Plough use across traditional societies in Ethiopia. Source: Alesina et al. (2013)

Alesina et al. (2013) On the Origins of Gender Roles: Women and the Plough

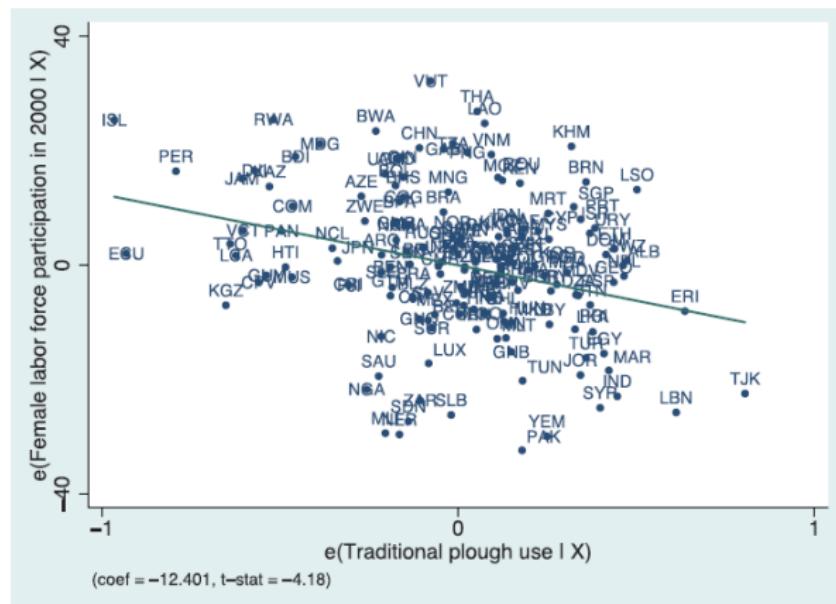


Figure 23: Plough use and Female LFP today. Source: Alesina et al. (2013)

Galor and Ozak (2016) Agricultural Origins of Time Preference

Time preferences (i.e., the ability to delay gratification, to wait and be patient, etc.) has enormous importance for savings behavior, for human capital investment, entrepreneurship, and ultimately, growth.

- Galor and Ozak (2016) show that variation in long-term orientation (LTO) can be explained by agro-climatic conditions that were conducive for higher returns from agricultural investment.
- Historically, societies with higher crop yields learned to foster patience and long-term orientation, as waiting (and consuming less) during the growing season paid off in the future.
- Descendants of societies that had higher crop yields have higher LTO even today.
- Moreover, in places where crop yields increased by a larger degree during the Columbian Exchange, the LTO has increased more.

Galor and Ozak (2016) Agricultural Origins of Time Preference

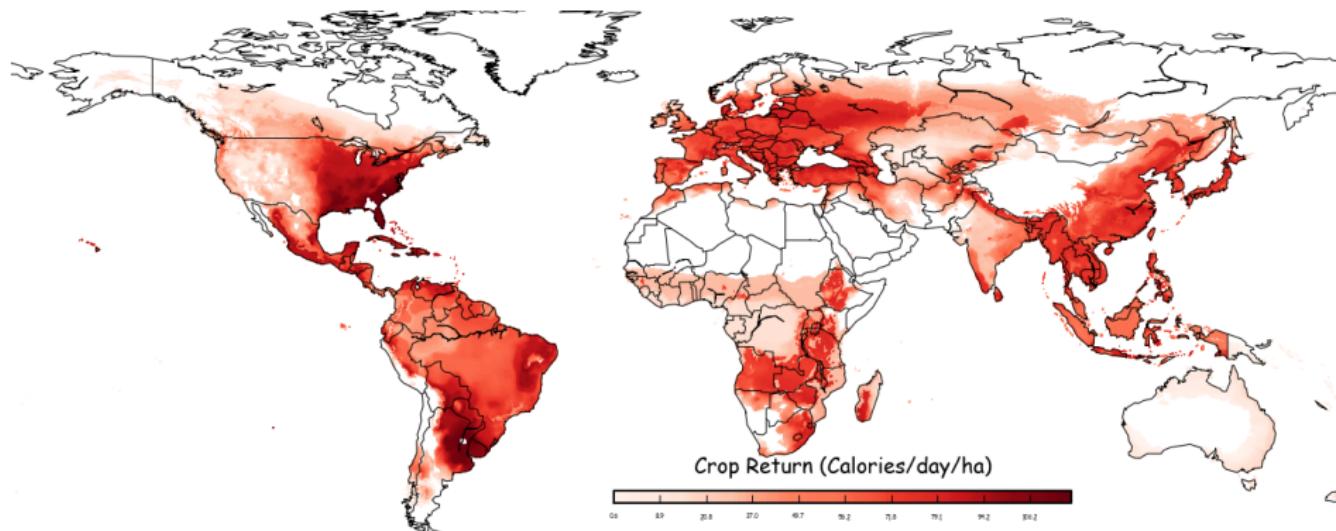
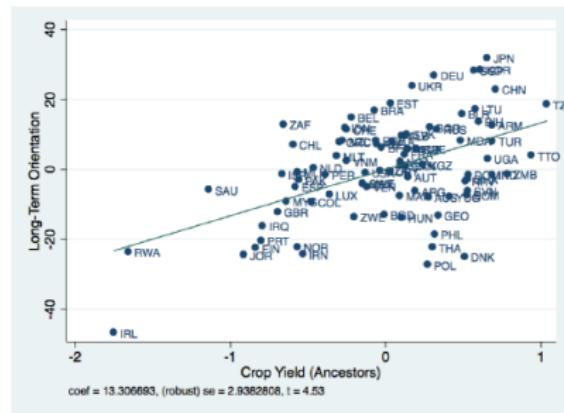


Figure 24: Distribution of potential crop yields across the globe. Source: Galor and Ozak (2016)

Galor and Ozak (2016) Agricultural Origins of Time Preference



The cumulative role of geography

The famous paper by Spolaore and Wacziarg (2013) documents that a relatively small set of geographic characteristics (latitude, % of area in tropics, landlocked status, island status):

- Explains 44% percent of variation in log GDP per capita in 2005.
- Explains 64% if one restricts the sample to the Old World (to limit the effects of post-1500 population movements)

Thus, the effects of geography (however they operate) are very large. But does it mean that prosperity is predetermined?

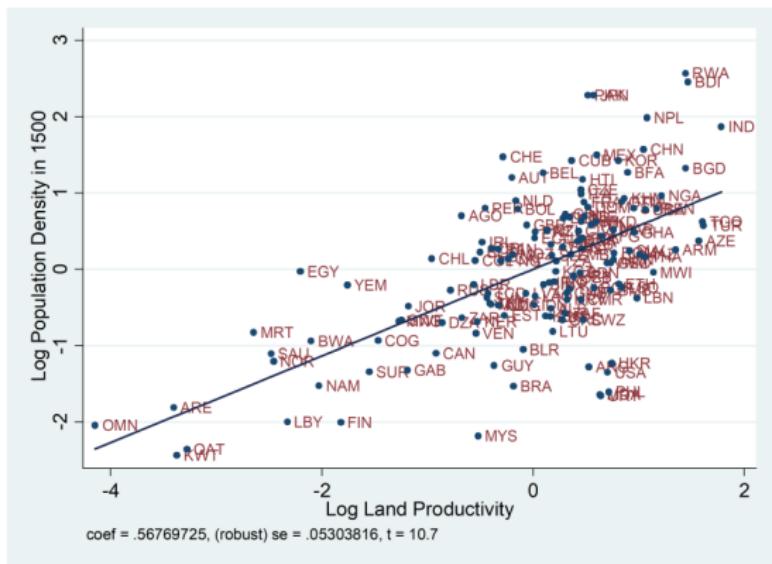
How persistent are the effects of geography?

Geography itself does not change much (at least, not until recently). Thus, does it mean that the wealth of nations was determined at the onset of civilizations?

Not really!

- The role of agricultural land productivity has switched from positive (historically) to negative (nowadays)
- The role of historical population density has also reversed from positive to negative
- "Reversal of Fortune"?

Reversal of Fortune

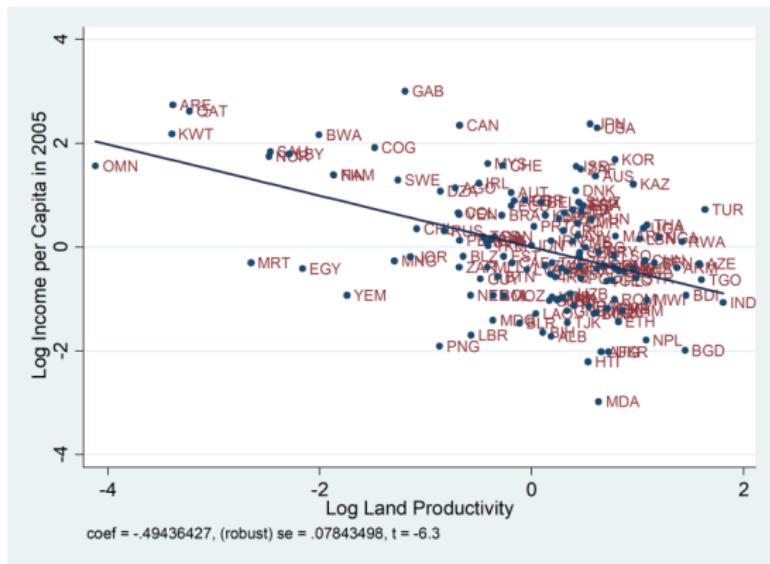


Conditional on years since Neolithic transition, geographical factors, and continental fixed effects.

Source: Ashraf-Galor (AER 2011)

Figure 26: Land Productivity and Population Density in 1500. Source: Ashraf and Galor (2011)

Reversal of Fortune



Conditional on years since Neolithic transition, geographical factors, and continental fixed effects.

Source: Ashraf-Galor (AER 2013)

Figure 27: Land Productivity and GDPpc in 2005. Source: Ashraf and Galor (2011)

Reversal of Fortune

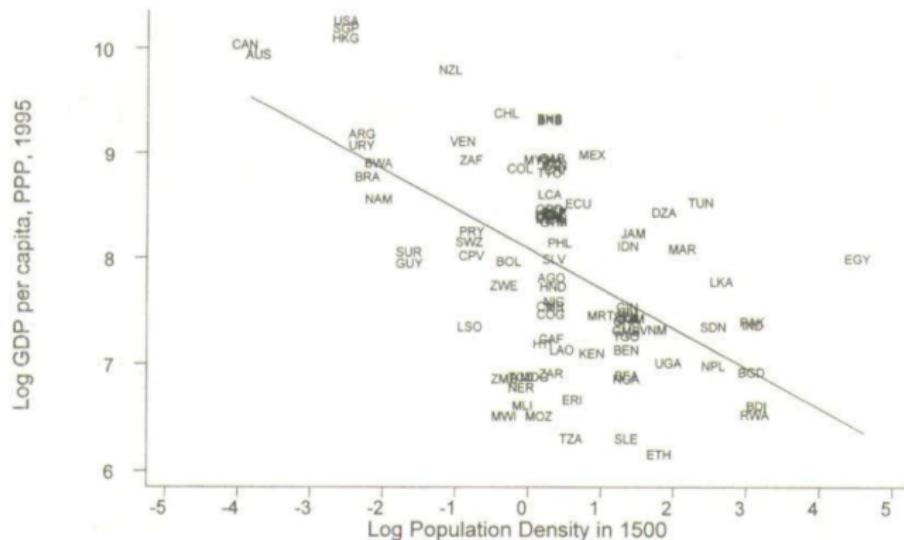


FIGURE II

Log GDP per Capita (PPP) against Log Population Density in 1500

Note. GDP per capita from the World Bank [1999]; log population density in 1500 from McEvedy and Jones [1978]. Details are in Appendix 2.

Figure 28: Population density in 1500 and GDPpc in 1995. Source: Acemoglu, Johnson, and Robinson (2002)

Reversal of Fortune

Reasons behind the "Reversal of Fortune":

- Acquired comparative advantage in agriculture & delayed industrial transformation, see Galor and Mountford (2008)
- For ex-colonies:
 - Institutions implemented by colonial powers: extractive institutions in densely populated areas, growth-friendly institutions in sparsely populated areas (from AJR (2002))
 - Effects of population characteristics: human capital and diversity of colonizers more pronounced in sparsely populated areas (from Glaeser et al. (2004) and Easterly and Levine (2016))

Is prosperity and growth pre-determined?

The short answer is 'no'!

- Even geography is not fixed (people move around, geography itself changes).
- And geography that was good for development 1000 years ago is not necessarily a positive correlate of development in year 2021 (like very high agricultural productivity)

Institutions change a lot, and can often change overnight (recall democratic and institutional transitions in Post-Soviet countries or in some East Asian countries)

Culture also does change over time, and reacts to institutional and economic environment.

We have not even talked about the role of political leaders, historical accidents, and sheer 'luck' that can push countries out of poverty

Malaria death toll

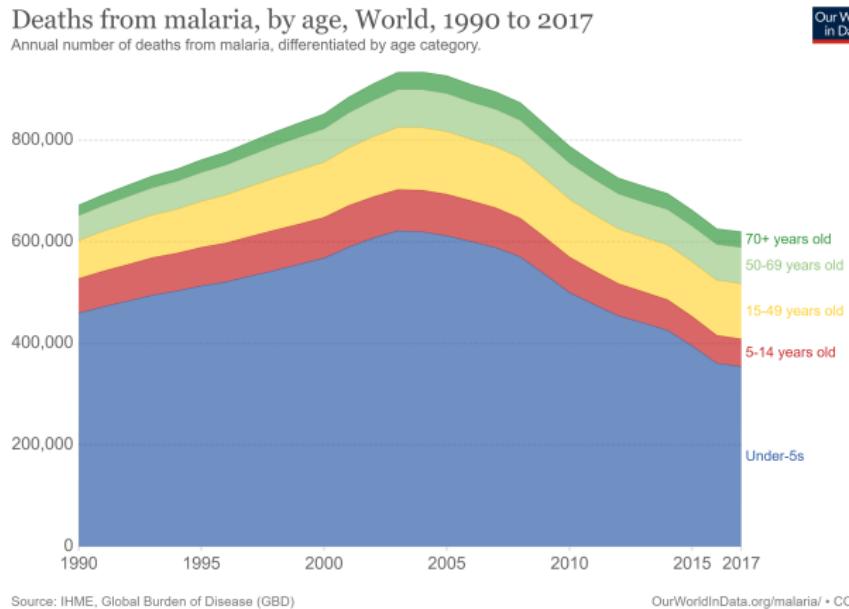


Figure 29: Malaria death tolls. Source: ourworldindata.org

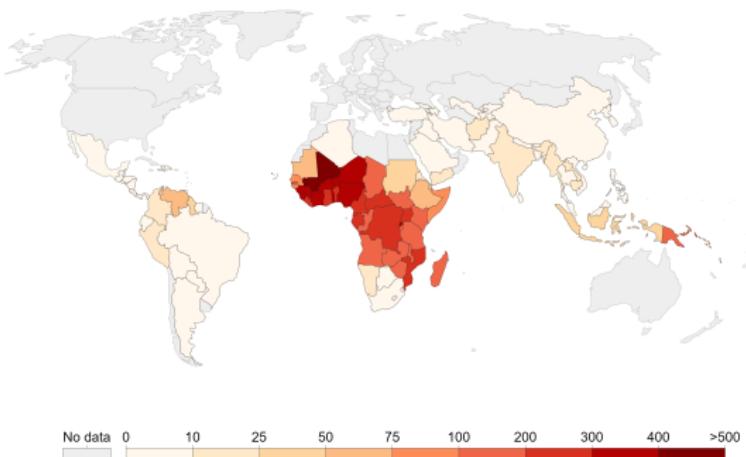
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Malaria incidence rates

Incidence of malaria

Incidence of malaria is the number of new cases of malaria per 1,000 population at risk.

Our World
in Data



Source: World Health Organization (WHO)

OurWorldInData.org/malaria • CC BY

Figure 30: Malaria incidence rates per 1000 across the world. Source: ourworldindata.org

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