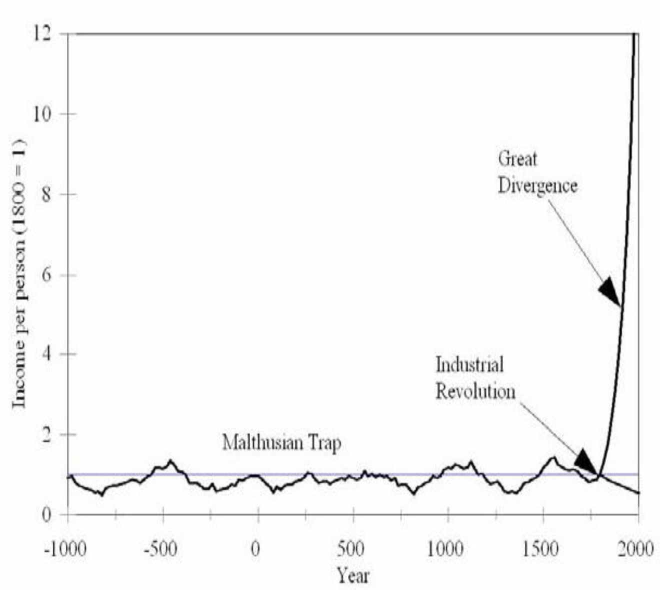
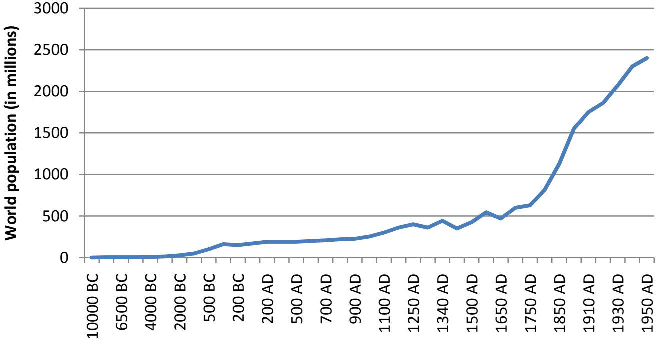
The Economic History of the World



A Brief Population History of the World



Population in the Preindustrial World

Location	Population in 1300	Population in 1800	Surviving children per woman
Norway	0.4	0.88	2.095
Southern Italy	4.75	7.9	2.061
France	17	27.2	2.056
England	5.8	8.7	2.049
Northern Italy	7.75	10.2	2.033
Iceland	0.084	0.047	1.93

Explaining Stationary Populations

- One of the key differences between the preindustrial world and the modern world was that population size was pretty much static
- It turns out that there is a very simple economic argument for why this was the case, the Malthusian trap
- The argument depends on three assumptions about how preindustrial economies worked:
  - Each society had a birth rate increasing with living standards
  - Each society had a death rate decreasing with living standards
  - Living standards decline as population increases

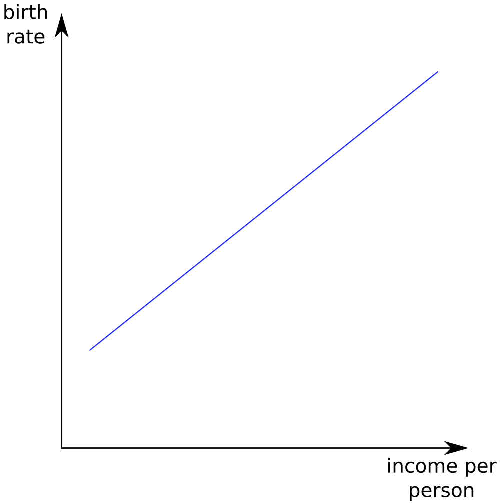
The Birth Rate Schedule

- The birth rate is just the number of births per year per thousand people
- For example, there were 4,059,000 births in the United States in 2000 and the US population was 281,421,906:

$$b_{2000} = \frac{4059000}{\frac{281421906}{1000}} = 14.4$$

- We assume that in the preindustrial world, birth rates rose with material living standards
- Why? A wealthier family could better afford an additional child, a healthier woman was more likely to have a successful pregnancy, ...

The Birth Rate Schedule



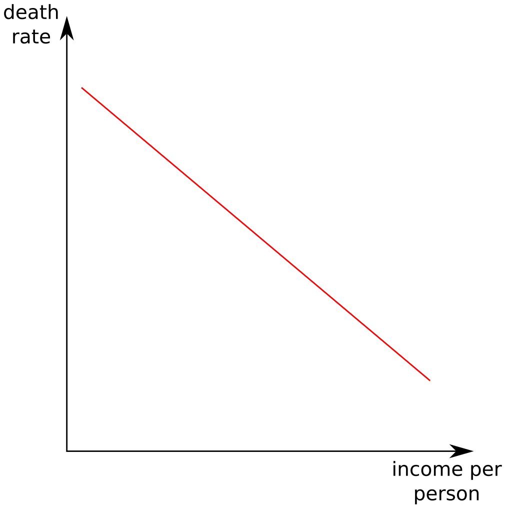
The Death Rate Schedule

- The death rate is just the number of deaths per year per thousand people
- For example, there were 2,403,000 deaths in the United States in 2000 and the US population was 281,421,906:

$$d_{2000} = \frac{2403000}{\frac{281421906}{1000}} = 8.5$$

- We assume that in the preindustrial world, death rates fell with material living standards
- Why? Higher levels of consumption (better food, clothing, shelter, etc.) helps you live longer

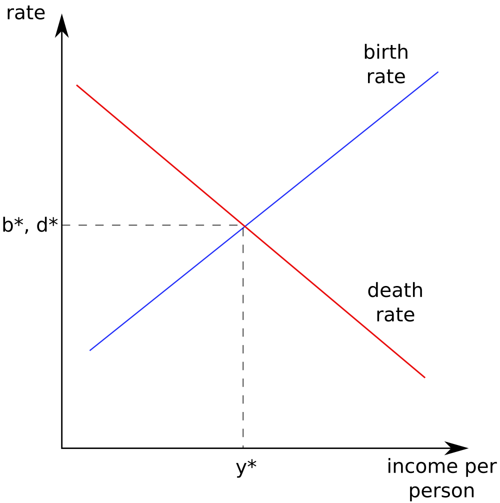
The Death Rate Schedule



Stationary Population

- Notice that for our US figures, the birth rate was 14.4 births per 1,000 people per year and the death rate was 8.5 deaths per 1,000 people per year
- This means that each year, more people are being born than are dying so population must be growing
- Recall that the preindustrial world had almost no population growth
- So in the preindustrial world, the birth rate roughly equaled the death rate (the income per person at which this occurs is called the *subsistence income*)

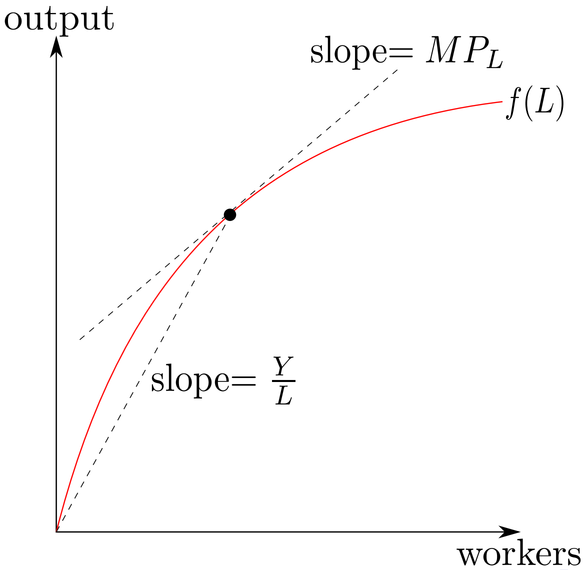
Stationary Population



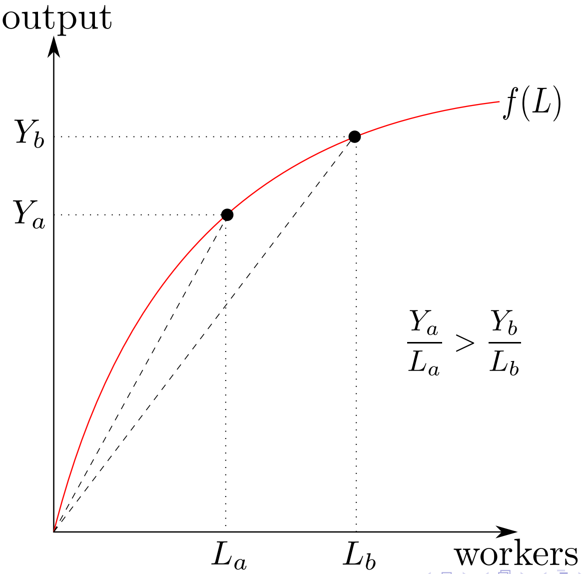
Stationary Population

- But why a stationary population?
- Because of the technology curve relating population to income per person
- With some resources fixed (for example land), the marginal product of an extra person is positive but smaller than the marginal product of the previous person
- This means that while total output increases as population increases, it increases at a slower rate than population

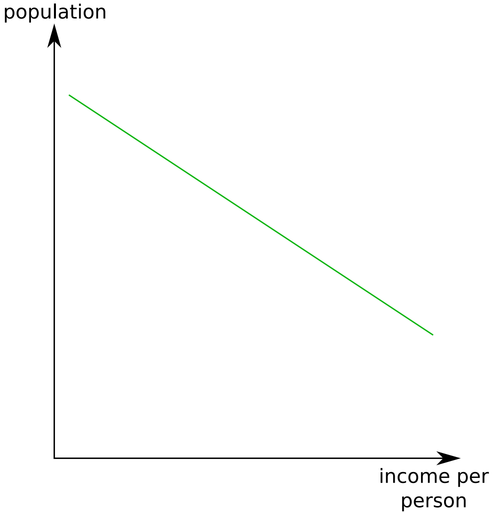
Diminishing Marginal Product and the Malthusian Trap



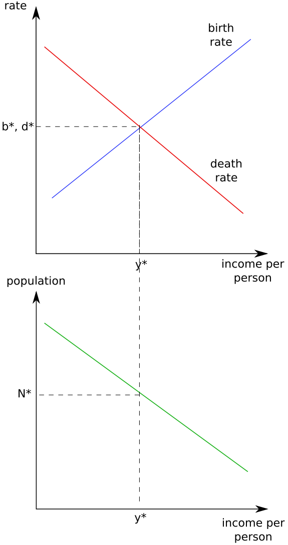
Diminishing Marginal Product and the Malthusian Trap



The Technology Curve



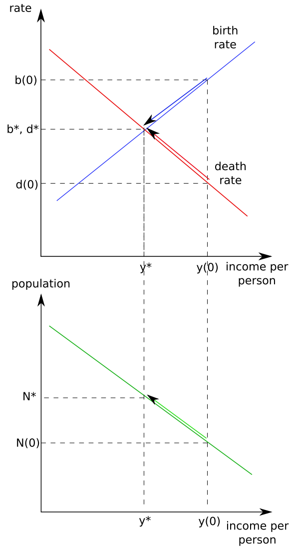
The Malthusian Equilibrium



Moving to the Malthusian Equilibrium

- Suppose we were at an income per person greater than the equilibrium level
- Then births would exceed deaths leading to population growth
- As the population grows, we move up and to the left along the technology curve
- This leads to lower income per person increasing the death rate and decreasing the birth rate
- Things stop moving once the birth rate equals the death rate

Moving to the Malthusian Equilibrium



Moving to the Malthusian Equilibrium

- Notice that equilibrium income per person had nothing to do with the level of technology
- Equilibrium income per person is determined entirely by the birth rate and death rate
- The technology curve mattered for two reasons:
  - The downward slope told us how income per person would change if the population was growing or shrinking
  - The position determined the equilibrium population level

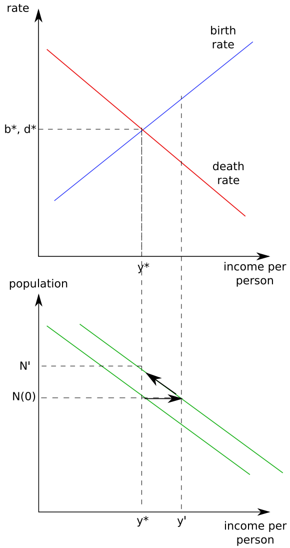
The Effects of a Change in Technology

Suppose that there is an improvement in technology (we invent the wheel). What happens?

- The advance in technology will shift the technology curve to the right
- In the short run (before population adjusts), this means greater income per person
- Births will rise, deaths will fall and the population will grow
- The economy returns to the old income per person only at a new higher population

So an improvement in technology can allow for greater population density but doesn't improve average income per person

The Effects of a Change in Technology

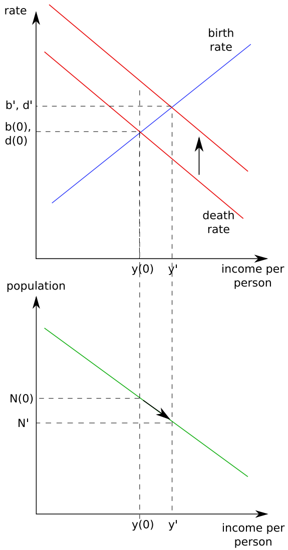


The Effects of a Change in the Birth or Death Schedules

A shift in the birth or death schedules can change equilibrium income per person. Suppose that the plague comes along, what happens?

- The rise in disease will shift the death rate curve up (more deaths at any given income level)
- At the current income per person, deaths will now outnumber births and the population will decrease
- As the population decreases, income per person will rise until deaths once again equal births
- The economy settles at a new higher income per person and a new lower population

A Shift in the Death Rate Curve



Change in the Malthusian World

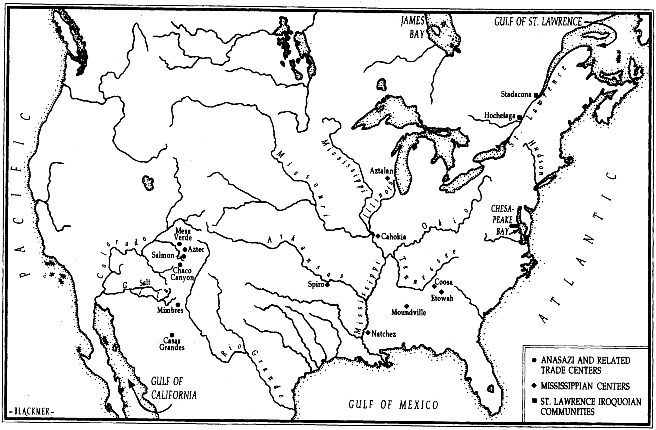
- The birth and death rate curves determine the subsistence income
- The technology curve determines the population size based on this subsistence income
- A change in technology can lead to a different population size in the long run but not a different subsistence income
- A change in the birth rate or death rate curve is the only way to change the long run subsistence income

The Economic State of the World in 1600

- So this is the world in which the modern American economy will gets its start
- Economies are constrained by this Malthusian trap
- These Malthusian forces limit population growth and gains in income per person when there are resource constraints
- Over the semester, we are essentially going to trace America's emergence out of this world into our modern world of steady population and income growth
- Let's start by thinking about the societies that pre-dated the arrival of Europeans

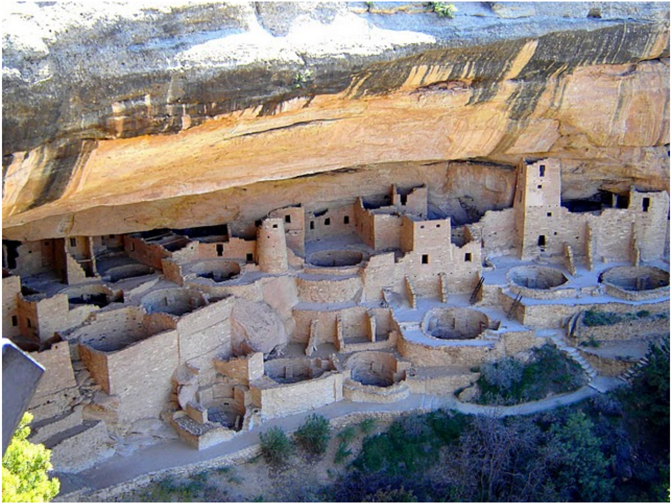
The Precolonial Economy

Selected Native American centers in North America, ca. 1250.



From "The Indians' Old World" by Neil Salisbury, William and Mary Quarterly, Vol. 53, No. 3, 1996

The Precolonial Economy



Anasazi (circa 1200 AD) ruins in Mesa Verde National Park

The Precolonial Economy

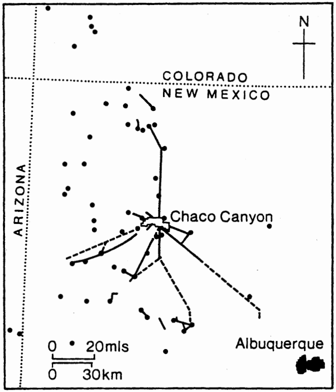
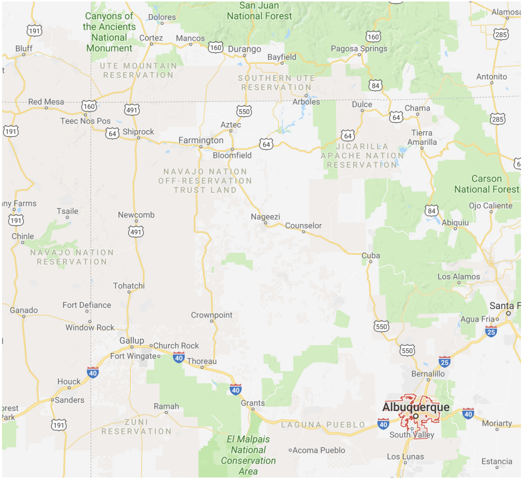


FIGURE V.

Chaco Canyon exchange system. Dots indicate sites of town and village outliers. Solid lines show roads documented by ground surveys; dashed lines are roads documented by aerial surveys. From *Ancient North America* by Brian M. Fagan, copyright © 1995 Thames and Hudson. Reprinted by permission of the publisher.

The Precolonial Economy



The Precolonial Economy

Historical city populations in North America and Europe

City	Time Period	Population
Cahokia (Mississippian)	12th century	20,000
Chaco Canyon (Anasazi)	12th century	15,000
London	1100	25,000
Paris	1150	50,000
Rome	1100	35,000

Chandler, Tertius, Four Thousand Years of Urban Growth, 1987.

The Precolonial Economy

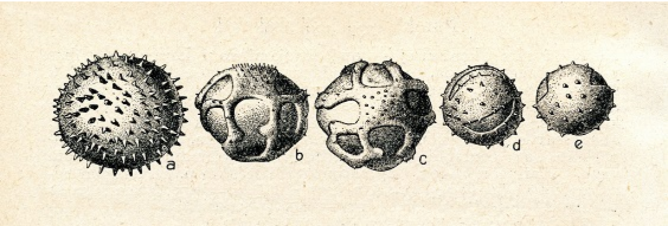
- How do we know about these economies?
- We certainly don't have the equivalent of modern economic indicators
- Instead, we need to rely on archeological evidence
- What can we learn about economic activity from archeological evidence?
- More than you might think

The Precolonial Economy

- Let's look at an example of what we've learned about the Anasazi with a recent paper by Axtell et al.
- Axtell et al. are going to combine a bunch of cool archeological data with economic theory to model Anasazi population growth and collapse
- The data come from a range of interesting techniques
- The theory comes from varied basic Econ 303-style constrained optimization
- First, the data

Axtell et al.

Dendroclimatology



Palynology

Axtell et al.

- Geology, archeology, palynology and dendroclimatology all give Axtell et al. a pretty good sense of low and high frequency in environmental conditions
- The idea is to use these data to fit a model of the Anasazi society
- From archeological sites, we have a sense of where and when the Anasazi lived
- Axtell et al. want to model migration, farming and family formation decisions as a function of environmental conditions
- Then you can estimate the model to try to match the observed spatial and temporal distribution of the Anasazi

Table 1. Household (agent) attributes

1. Five surface rooms or one pithouse is considered to represent a single household.
2. Each household that is both matrilineal and matrilocal consists of 5 individuals. Only female marriage and residence location are tracked, although males are included in maize-consumption calculations.
3. Each household consumes 160 kg of maize per year per individual.
4. Each household can store a maximum of 2 years' total corn consumption (1,600 kg), i.e., if at harvest 800 kg of corn remains in storage and additional 800 kg can be added to that from the current crop.
5. Households use only 64% of the total potential maize yield. (The unutilized production is attributed to fallow, loss to rodents, insects, and mildew, and seed for the next planting.)

Axtell et al.

Table 2. Household (agent) rules

1. A household fissions when a daughter reaches the age of 15.
2. A household moves when the amount of grain in storage in April plus the current year's expected yield (based on last year's harvest total) falls below the amount necessary to sustain the household through the coming year.
   A. Identification of agricultural location:
      The location must be currently unfarmed and uninhabited.
      The location must have potential maize production sufficient for a minimum harvest of 160 kg per person per year (22). Future maize production is estimated from that of neighboring sites.
      If multiple sites satisfy these criteria the location closest to the current residence is selected.
      If no site meets the criteria the household leaves the valley.
   B. Identification of a residential location:
      i. The residence must be within 1 km of the agricultural plot.
      ii. The residential location must be unfarmed (although it may be inhabited, i.e., multihousehold sites permitted).
      iii. The residence must be in a less productive zone than the agricultural land identified in A.
      If multiple sites satisfy these above criteria the location closest to the water resources is selected.
      If no site meets these criteria they are relaxed in order of iii then i.

Axtell et al.

Fig. 2. Best single run of the model according to the L^1 norm. Other best runs based on other norms yield very similar trajectories. The average run, produced by averaging over 15 distinct runs, looks quite similar to this one as well.

Axtell et al.

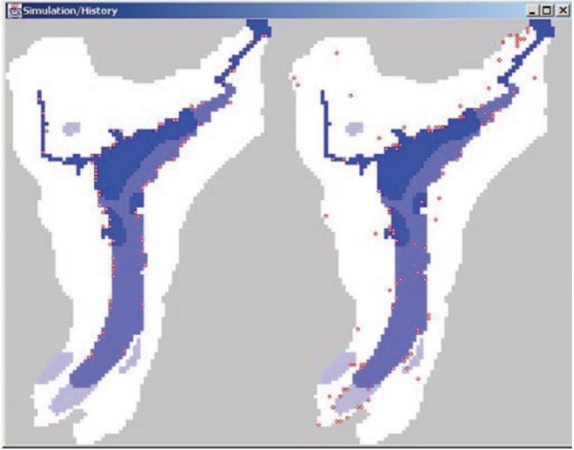


Fig. 3. Simulated and historical settlement patterns, in red, for Long House Valley in A.D. 1125; North is to the top of the page.

The Precolonial Economy

- What about understanding more complex dimensions of the economy?
- The climate data may not be as relevant here but there are other things to look at
- Let's take a quick look at the evidence used in a paper by Maggiano et al. on a Mayan society from 500 AD
- Archeology tells us that this site, Xcambo, was a center for salt production but then shifted to a more administrative role as a commercial port
- Maggiano et al. want to know how daily occupations of Xcambo inhabitants changed

Maggiano et al.

Fig. 1. Map of Yucatan.

Maggiano et al.

- Maggiano et al. are going to make a couple of hypotheses about the impact of switching from salt production to commercial port
- First, male occupations should switch from harsh labor to administrative employment requiring less physical demand and reduced mobility
- Second, female occupations would not change significantly as it was primarily males involved in salt production
- How do you find evidence to test these changes?
- In bones

Maggiano et al.

Maggiano et al.

TABLE 1. Humeral robusticity (CA[a] and Zp[b]) by side and sex

		Males						Females						Sex. dif.[c]	
			Right		Left				Right		Left				
	Group	n	Mean	SD	Mean	SD	Side dif.[d]	n	Mean	SD	Mean	SD	Side dif.[d]	Rt.	Lt.
CA	EC	6	355.1	39.3	342.7	31.0	4.3%	7	235.5	38.9	238.3	36.8	4.5%	50.8%***	43.8%***
	LC	24	314.0	36.6	303.5[e]	37.4	4.8%*	14	254.0	33.1	254.5	36.3	4.4%	23.8%***	19.3%***
Zp	EC	6	60.3	8.5	55.4	7.5	9.1%*	4	32.2	1.9	33.8	3.2	7.1%	87.3%***	63.9%***
	LC	15	50.5[e]	7.0	46.7[e]	6.9	9.2%***	8	35.3	4.6	35.4	5.9	6.5%	42.3%***	31.9%***

EC = Early Classic; LC = Late Classic.
Levels of significance: *$P \leq 0.05$, ***$P \leq 0.001$.
[a] Standardized by body weight.
[b] Standardized by body weight and bone length × 1000.
[c] Percent sexual dimorphism between male and female values = 100 × (male mean – female mean)/female mean; independent samples t-test.
[d] Percent asymmetry between right and left side values = 100 × (maximum – minimum)/minimum; t-test for paired variables.
[e] Statistically significant difference between EC and LC mean; tested by independent samples t-test; significance level: $P \leq 0.05$.

Why Do We Speak English?

- Europeans didn't arrive to an empty continent
- Relatively large population centers existed
- Economies had evolved to include complex political structures, agriculture, division of labor, trade over long distances, etc.
- So why are we an English speaking country today?

Why Do We Speak English?

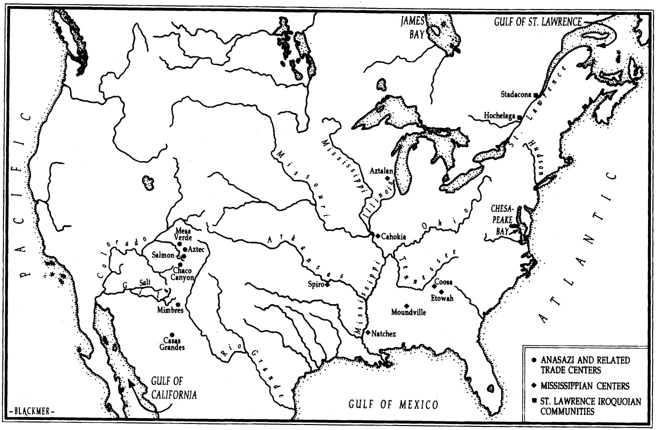
- Salisbury touches on this, emphasizing ecological crises
- This is essentially an argument about a Malthusian trap of the sort we have discussed
- But Europe had similar issues of a Malthusian trap
- What differences led to Europeans being able to take control of North America?

Announcements

- Office hours on this coming Monday are cancelled
- We will discuss the referee report assignment in Tuesday's class
- Upcoming required readings:
  - We're going through Feir, Gillezeau and Jones (2017) today
  - Next week we'll get to Sawers (1992) and the Federalist Papers

The Precolonial Economy

Selected Native American centers in North America, ca. 1250.



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The Precolonial Economy

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Chandler, Tertius, Four Thousand Years of Urban Growth, 1987.

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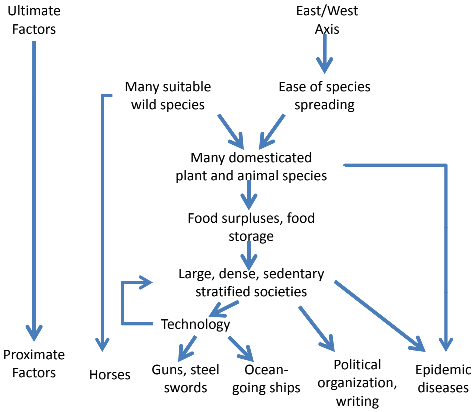
Why Do We Speak English?

Fig. 2. Best single run of the model according to the L^1 norm. Other best runs based on other norms yield very similar trajectories. The average run, produced by averaging over 15 distinct runs, looks quite similar to this one as well.

Why Do We Speak English?

- Salisbury and Axtell touch on this, emphasizing ecological crises
- This is essentially an argument about a Malthusian trap of the sort we have discussed
- But Europe had similar issues of a Malthusian trap and many Native American societies had not run into dire ecological crises
- What differences led to Europeans being able to take control of North America?

Guns, Germs, and Steel



Theory proposed by Jared Diamond in "Guns, Germs, and Steel"

Guns, Germs, and Steel

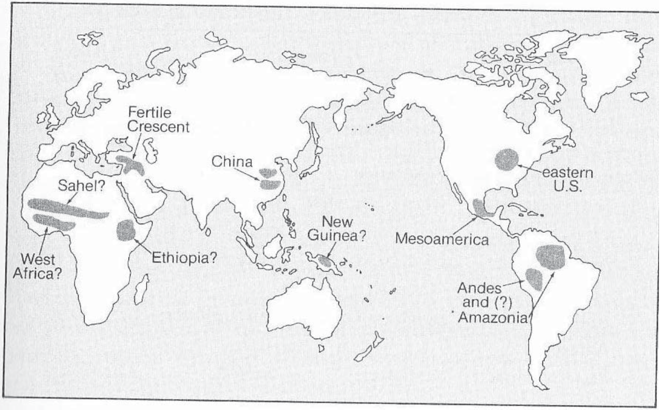


Figure 5.1. Centers of origin of food production. A question mark indicates some uncertainty whether the rise of food production at that center was really uninfluenced by the spread of food production from other centers, or (in the case of New Guinea) what the earliest crops were.

From Jared Diamond, "Guns, Germs, and Steel", 1997

Guns, Germs, and Steel

Mammalian Candidates for Domestication

	Eurasia	Sub-Saharan Africa	The Americas	Australia
Candidates	72	51	24	1
Domesticated species	13	0	1	0
Percentage of candidates domesticated	18%	0%	4%	0%

Candidate is defined as a species of terrestrial, herbivorous or omnivorous, wild mammal weighing over 100 pounds.

The Major Five

Domesticated animal	Location of wild ancestor
Sheep	West and Central Asia
Goat	West Asia
Cow	Eurasia and North Africa
Pig	Eurasia and North Africa
Horse	Russia

The Minor Nine

Domesticated animal	Location of wild ancestor
Arabian camel	Arabia
Bactrian camel	Central Asia
Llama and alpaca	Andes
Donkey	North Africa (maybe Southwest Asia)
Reindeer	Eurasia
Water buffalo	Southeast Asia
Yak	Himalayas
Bali cattle	Southeast Asia
Mithan	India

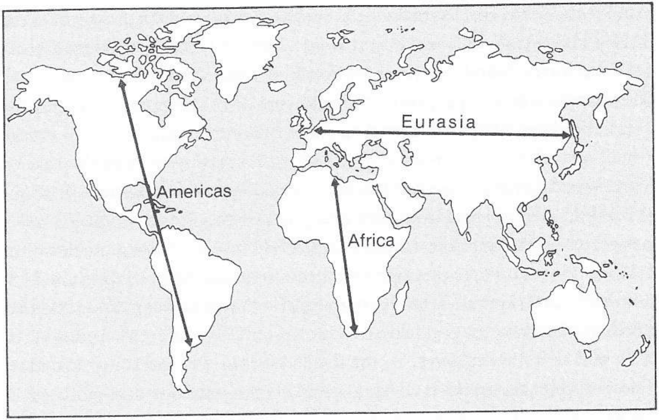


Figure 10.1. Major axes of the continents.

From Jared Diamond, "Guns, Germs, and Steel", 1997

Guns, Germs, and Steel

Summary

Temperature (° F)	Max	Average	Min	Sum
Max Temperature	80	70	62	-
Avg Temperature	70	54	39	-
Min Temperature	55	44	28	-
Precipitation (Inches)	Max	Average	Min	Sum
Precipitation	0	0	0	0
Dew Point (° F)	Max	Average	Min	Sum
Dew Point	63	31	3	-

October 2017, Albequerque

Summary

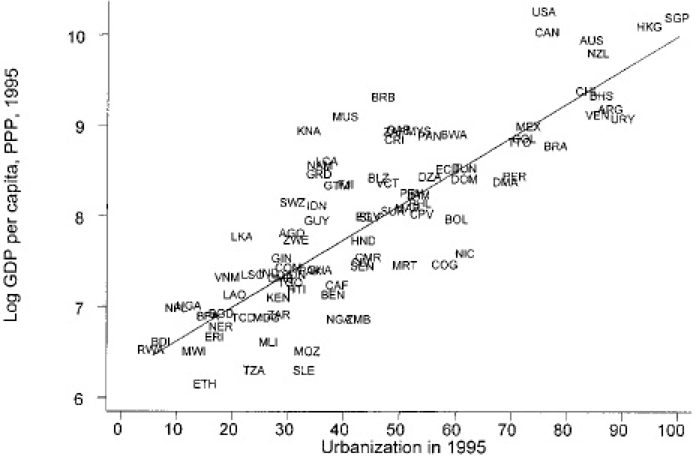
Temperature (° F)	Max	Average	Min	Sum
Max Temperature	89	78	71	-
Avg Temperature	71	62	52	-
Min Temperature	41	37	30	-
Precipitation (Inches)	Max	Average	Min	Sum
Precipitation	1.72	0.15	0	3.71
Dew Point (° F)	Max	Average	Min	Sum
Dew Point	73	50	18	-

October 2017, St. Louis

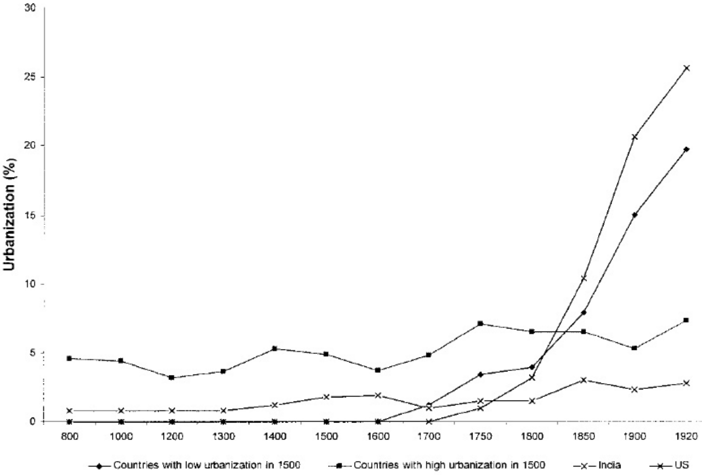
The Arrival of Europeans

- Let's look at a case where there was a clash of societies
- In particular, we'll look at "The Slaughter of the Bison and Reversal of Fortunes on the Great Plains" by Feir, Gillezeau and Jones
- It's a case where actions of the European settlers dramatically altered the Native American economy with long run effects
- First things first, what do we mean by reversal of fortunes?

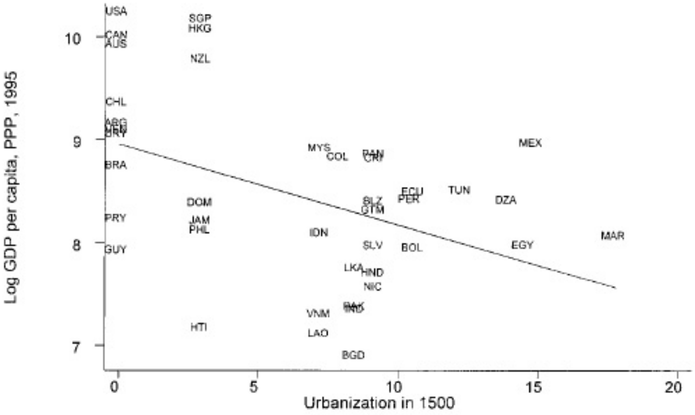
Reversal of Fortunes



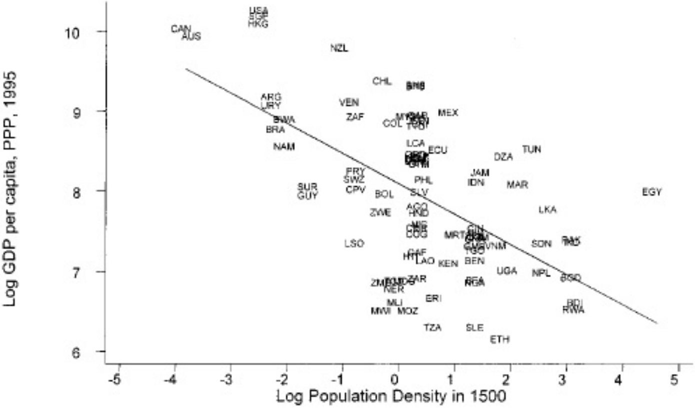
Reversal of Fortunes



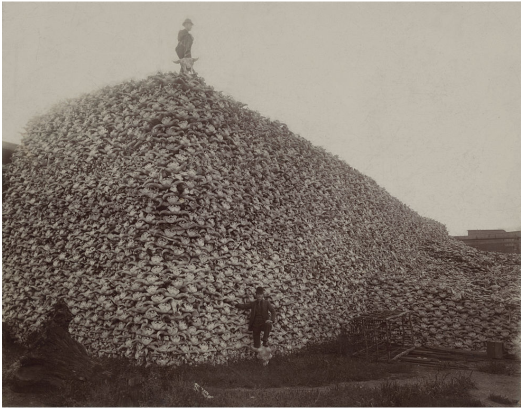
Reversal of Fortunes



Reversal of Fortunes



Back to Bison

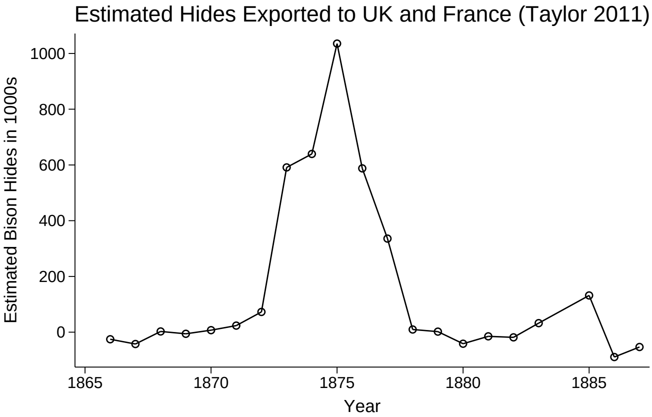


The Slaughter of the Bison

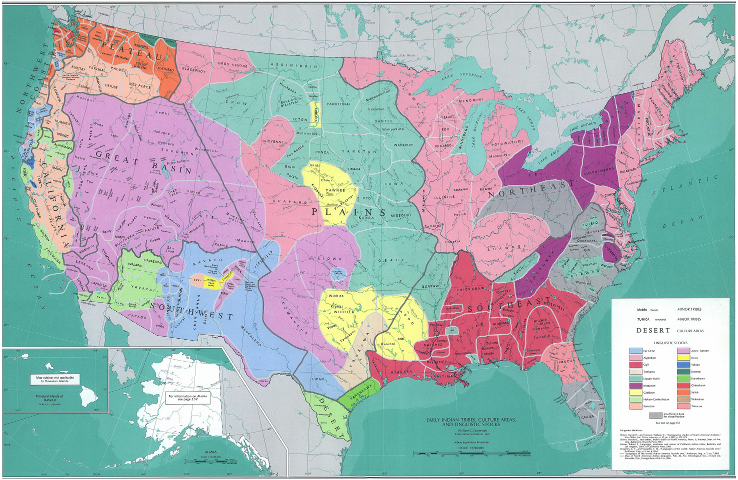
- The basic idea of the paper is to see how the loss of the bison impacted the standard of living of bison-dependent societies in the short run and the long run
- Key to the paper is that the decline of the bison was both slow and rapid
- In some regions, the bison decline was gradual, beginning with the introduction of the horse and European settlers
- In other regions, the decline was rapid, occurring in roughly a decade

The Slaughter of the Bison

The Slaughter of the Bison



The Slaughter of the Bison



The Slaughter of the Bison

- Given the bison map and the ancestral territories map, you can determine which societies were hit by the slow or rapid decline of the bison
- The next task is to find measures of relevant outcomes
- This is not as simple as you'd think, both because of time periods and unique problems of studying Native Americans
- Ultimately, several different outcome measures are used including heights, occupational data, and nighttime light data

The Slaughter of the Bison

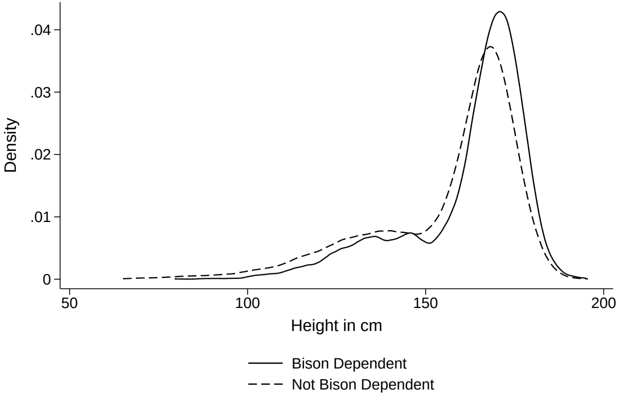


Figure A3: This figure plots the density of standing height from Franz Boas' sample 1890 to 1901. N=9,075. Societies are classified as bison-reliant when more than 60% of their ancestral territory was covered by the historic bison range and non-bison-reliant if it was less than this. A similar pattern is visible if a threshold of 80% or 40% is used.

The Slaughter of the Bison

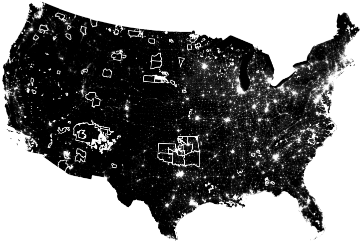


Figure 3: The distribution of nighttime lights in 2000 overlaid with Native American homelands or reservation boundaries in 2013.

The Slaughter of the Bison

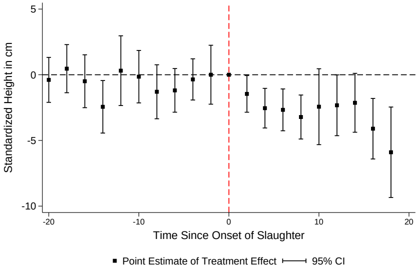
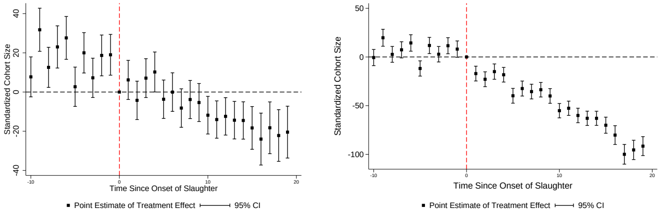


Figure 4: Coefficients on indicators for each two-year of birth before and after the slaughter interacted with whether the tribe obtained most of its calories from bison at least during part of the year. The dependent variable is height in cm and conditions on age fixed effects, a dummy for "full blood", the tribe being located in Canada, whether a railway entered the traditional territory of the tribe and the number of years since your year of birth the railway had been present, and for whether the respondent had been born during a period of war. Data is from Franz Boas' 1889 to 1903 sample, N=7,321 (males).

The Slaughter of the Bison



(a) Full sample (b) Bison-reliant: gradual vs. rapid

Figure 5: Coefficients on indicators for each two-year of birth before and after the slaughter interacted with whether the tribe obtained most of its calories from bison at least during part of the year. The dependent variable is the weighted number of people observed in that cohort and conditions on age fixed effects. Data is from the IPUMS 1900 and 1910 Census Over-sample. Given that some tribe-birth year combinations have no observations, we impute a population size of zero.

The Slaughter of the Bison

Table 4: Correlation between Standardized Occupational Rank and Tribe Historic bison-reliance in 1910 and 1930

	1910	1930	1910	1930
	Full Sample		Only Bison-reliant	
Share lost as of 1870	0.0431	0.126		
	(0.191)	(0.118)		
Share lost as of 1889	-0.582	-0.474	-0.604	-0.720
	(0.211)	(0.155)	(0.201)	(0.164)
Age	0.111	0.0726	0.100	0.100
	(0.026)	(0.031)	(0.046)	(0.052)
Age-Squared	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Constant	-2.234	-1.195	-1.825	-1.962
	(0.418)	(0.628)	(0.920)	(1.121)
Observations	463	620	225	296
Adjusted R^2	0.067	0.086	0.038	0.125

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Table 5: Correlation between the Share of Bison Covering Traditional Territory and Income Per Capita by Reservation in 2000

	(1)	(2)	(3)	(4)	(5)
Original Share	-2588.3				
	(823.913)				
Share lost as of 1870		-1632.6		-2015.0	
		(894.083)		(892.423)	
Share lost as of 1889			-3918.5	-4380.3	-2556.2
			(590.392)	(671.006)	(616.157)
Constant	11074.9	10553.0	10355.2	11038.3	9213.4
	(618.927)	(599.328)	(441.578)	(624.817)	(500.193)
Observations	197	197	197	197	72
Adjusted R^2	0.053	0.014	0.037	0.060	0.045

Notes: Clustered standard errors at the tribe level in parentheses. The last column only includes tribes for whom at least 60% of their original territory was covered by bison.

The Slaughter of the Bison

- The short run negative effects seem quite plausible
- But why the medium and long run effects?
- Why would subsequent generations still suffer from the slaughter of the bison?
- Two interesting mechanism are raised by Feir, Gillezeau and Jones
  - The transferability of human capital
  - Constraints on mobility from federal policies

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Table 13: Correlation between Share of Bison Covering Traditional Territory and Income Per Capita Adjusted for Experience with Agriculture

	(1)	(2)	(3)
Share lost as of 1870	-3884.2	-2294.6	-1098.5
	(1494.426)	(1210.170)	(1217.349)
Share lost as of 1870 X AG Cal	941.4	26.41	-341.3
	(344.777)	(341.150)	(394.416)
Share lost as of 1889	-2998.7	-4370.0	-4866.3
	(1390.663)	(1499.165)	(1580.858)
Share lost as of 1889 X AG Cal	1490.4	2836.9	4290.2
	(922.949)	(1129.248)	(1345.322)
Cultural Controls	X	X	X
Soil Quality Controls	X	X	X
Colonial Controls		X	X
Contemporary Controls			X
Observations	197	197	197
Adjusted R^2	0.113	0.292	0.420

Notes: Clustered standard errors at the tribe level in parentheses. "Cultural controls" include calories from agriculture, historic centralization, measures of nomadism, jurisdictional hierarchy, wealth distinctions, log ruggedness and population in 1600. "Colonial controls" include being involved in an Indian war, a measure of forced co-existence, and distance displaced from traditional territory. "Contemporary controls" include nearby income per capita, log distance to the nearest city, presence of a casino. "Soil Quality controls" include share of reservation land without constraints from excess salts, nutrient availability, nutrient retention, rooting conditions, oxygen availability, toxicity, and workability.