

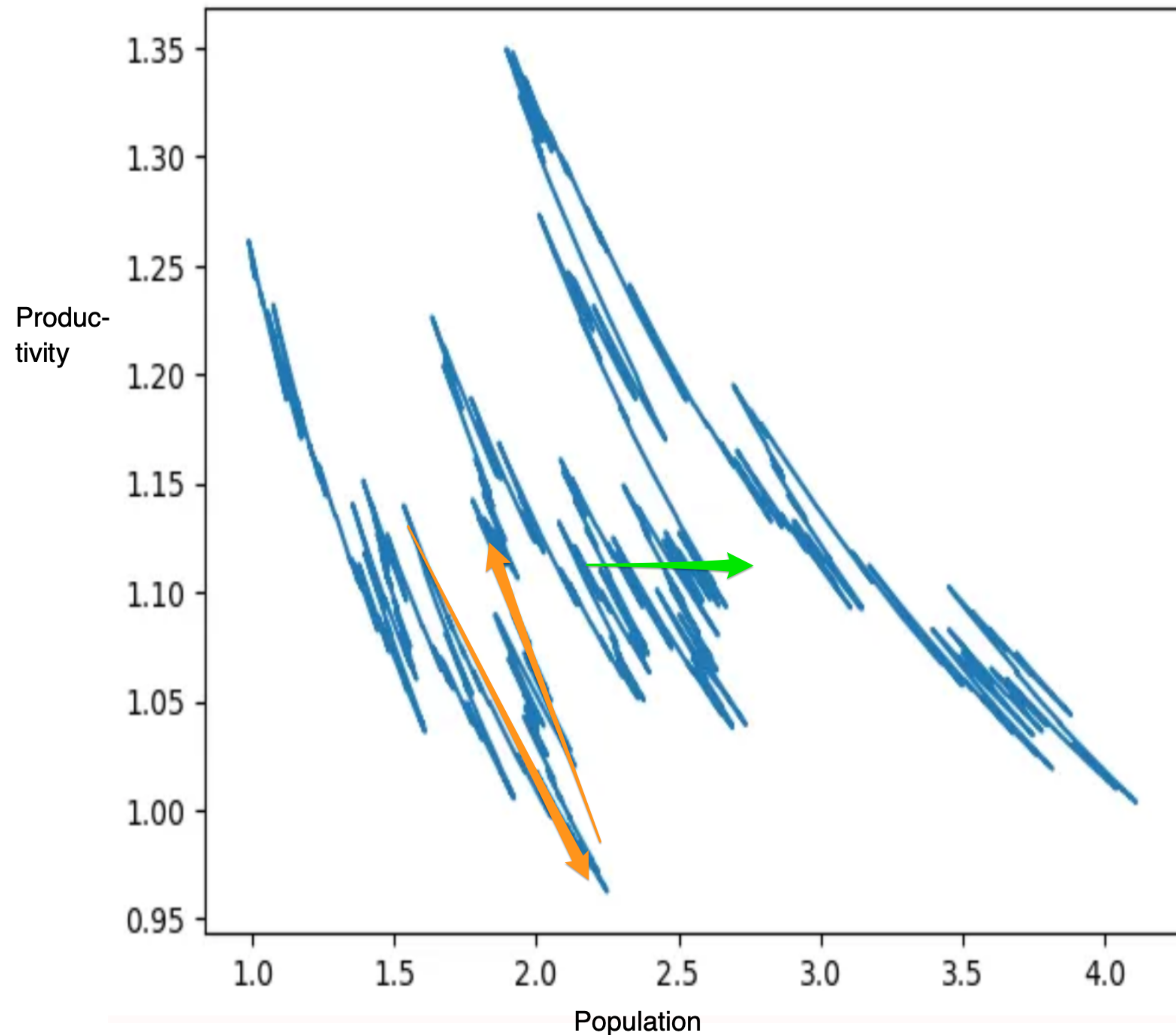
# Econ 135: Day 4: Efflorescences & Dark Ages





# What Kinds of Things Happen in a Malthusian Economy?

## Population and Productivity in a Malthusian Economy



## A thumbnail summary:

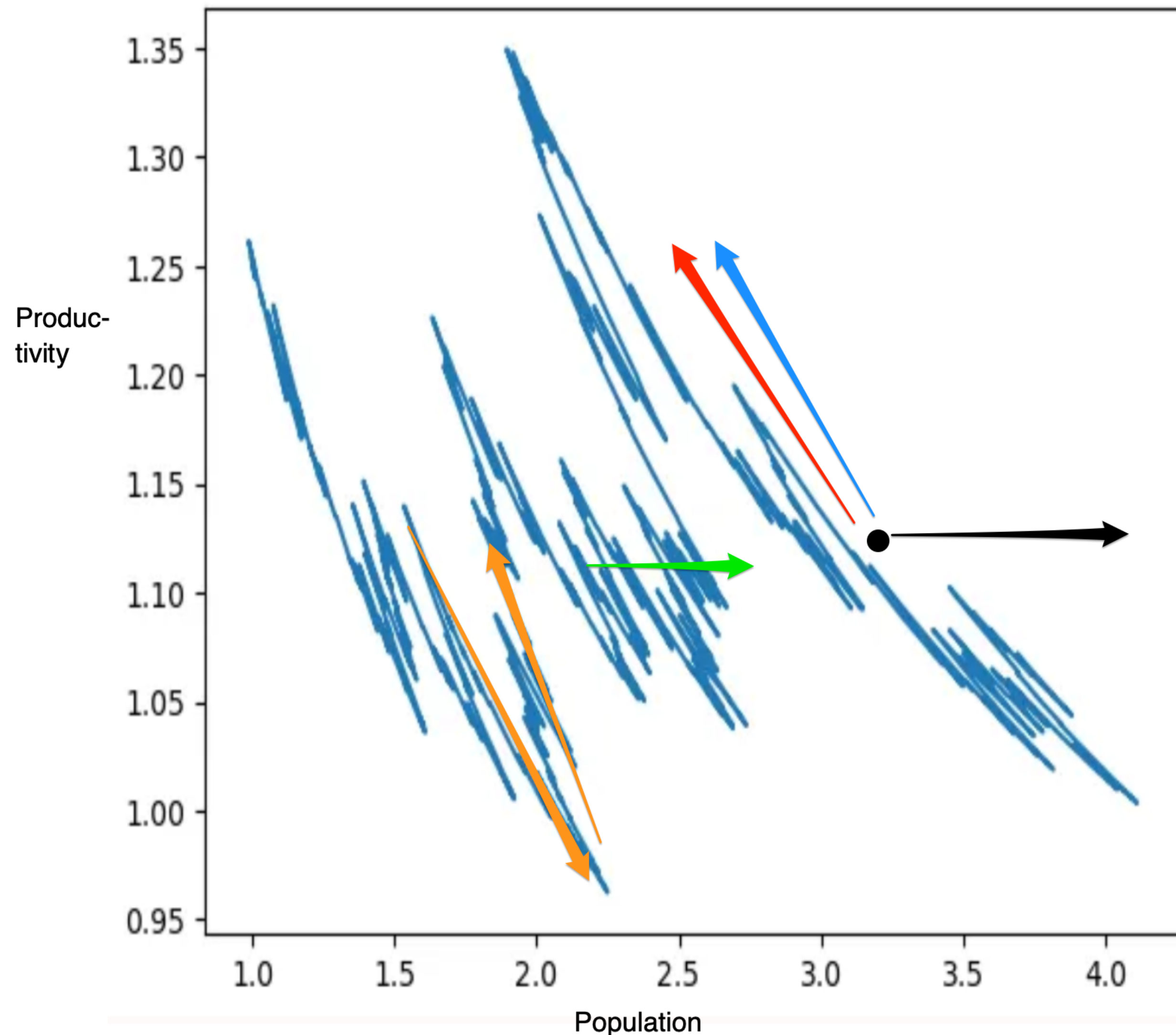
- **Analytic geometry:** Describe the economy as two numbers (population, productivity); represent that number-pair as a point; think of changes over time in those numbers as movement over time of the point
- **Transitory fluctuations up-and-left and down-and-right around the Malthusian equilibrium (orange):** M.M. Postan's "respiration"
- **Slow rightward drift (green)** as technology slowly advances, and population grows at the constant near-subsistence level of productivity and living standards



# What Kinds of Things Happen in a Malthusian Economy?

## II

Population and Productivity in a Malthusian Economy



And also:

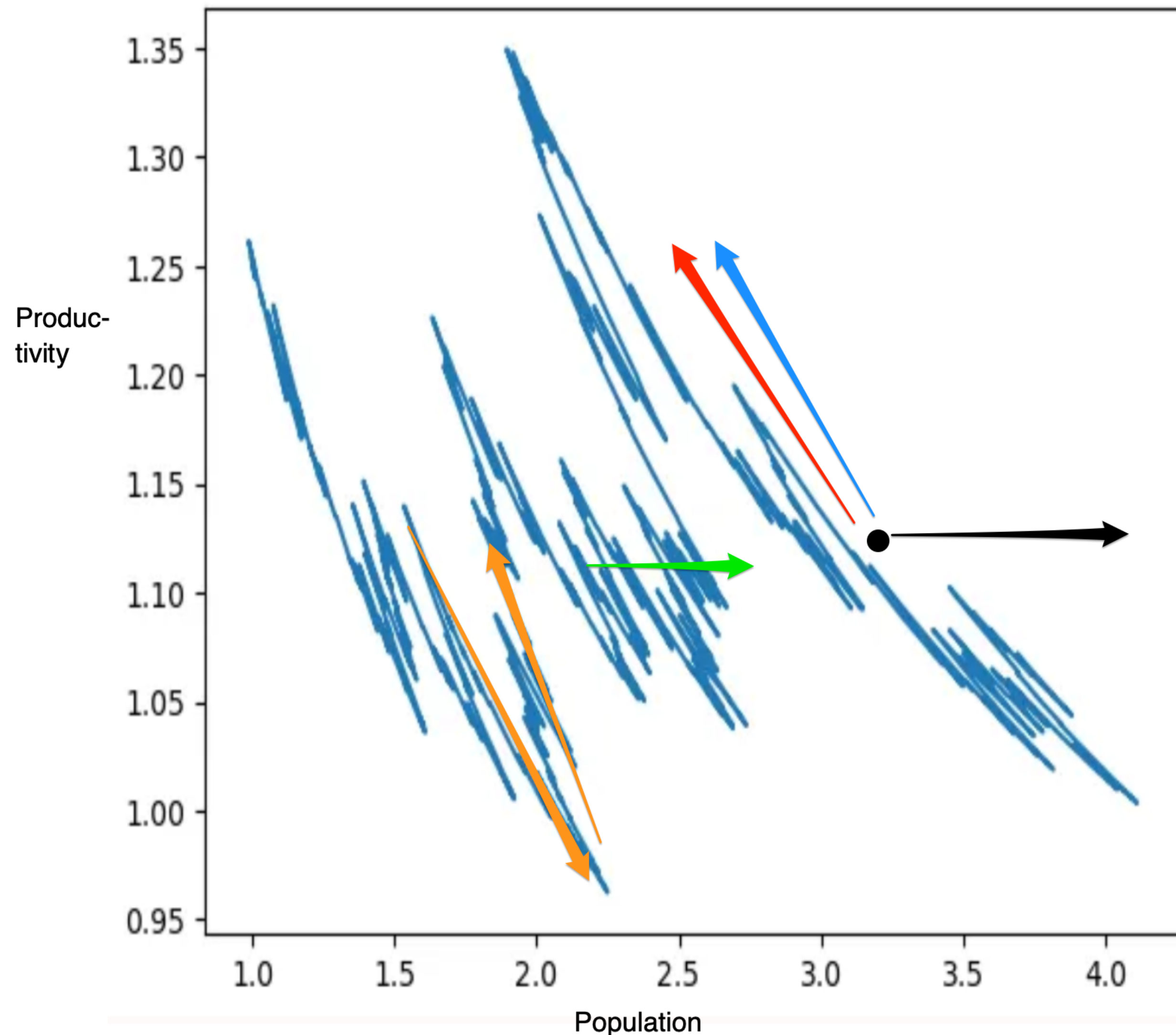
- **Permanent increase (decrease) in required-subsistence  $y^{\text{sub}}$ : up-and-left (red)**
- **Permanent increase (decrease) in taste-for-luxuries  $\phi$ : up-and-left (blue)**
- **Permanent increase (decrease) in security and profitability and thus in savings-investment  $s$ : rightward (black)**



# What Kinds of Things Happen in a Malthusian Economy?

## III

Population and Productivity in a Malthusian Economy



Some of these go together?

- **Rise of an empire?**
- **Rise of a commercial network?**
- **Successful barbarian invasion?**
- **Religious transformation?**



# Differing Malthusian Setpoints

Malthusian equilibrium income level

$$y^{*mal} = \phi y^{sub} \left( 1 + \frac{n^{*mal}}{\beta} \right) = \phi y^{sub} \left( 1 + \frac{\gamma h}{\beta} \right)$$

Taste for luxuries

Responsiveness of population growth to prosperity

True zpg subsistence

Sensitivity of productivity to population

Rate of useful ideas creation

The ratio of knowledge to subsistence income

The Malthusian equilibrium population

The salience of capital in determining productivity

The ratio of savings to depreciation

The extent to which population depresses productivity

Nuisance terms

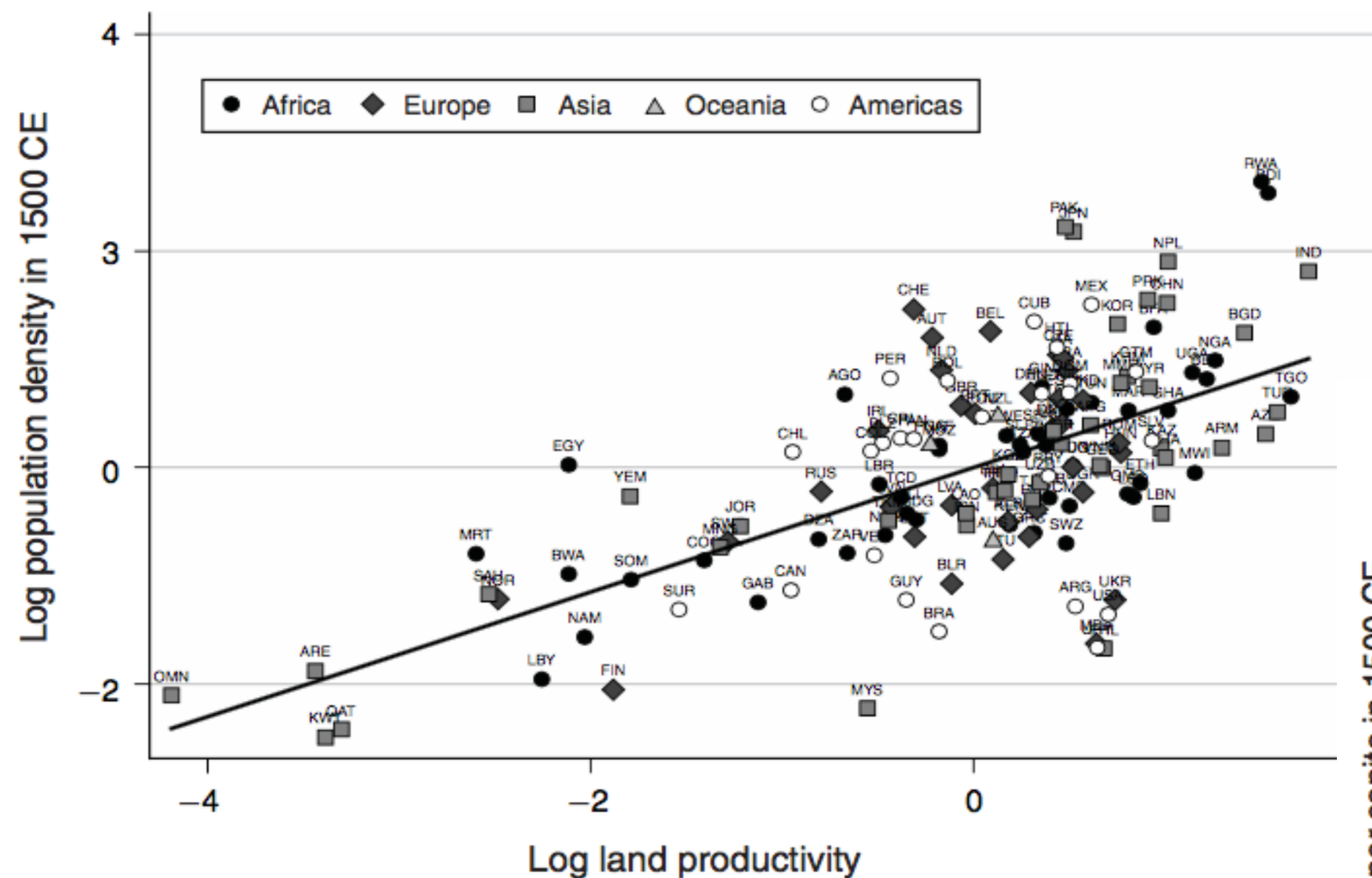
The inverse of the taste for luxury

$$L_t^{*mal} = \left[ \left( \frac{H_t}{y^{sub}} \right) \left( \frac{s}{\delta} \right)^\theta \left( \frac{1}{\phi} \right) \left[ \frac{1}{(1+\gamma h/\delta)^\theta} \frac{1}{(1+\gamma h/\beta)} \right] \right]^\gamma$$

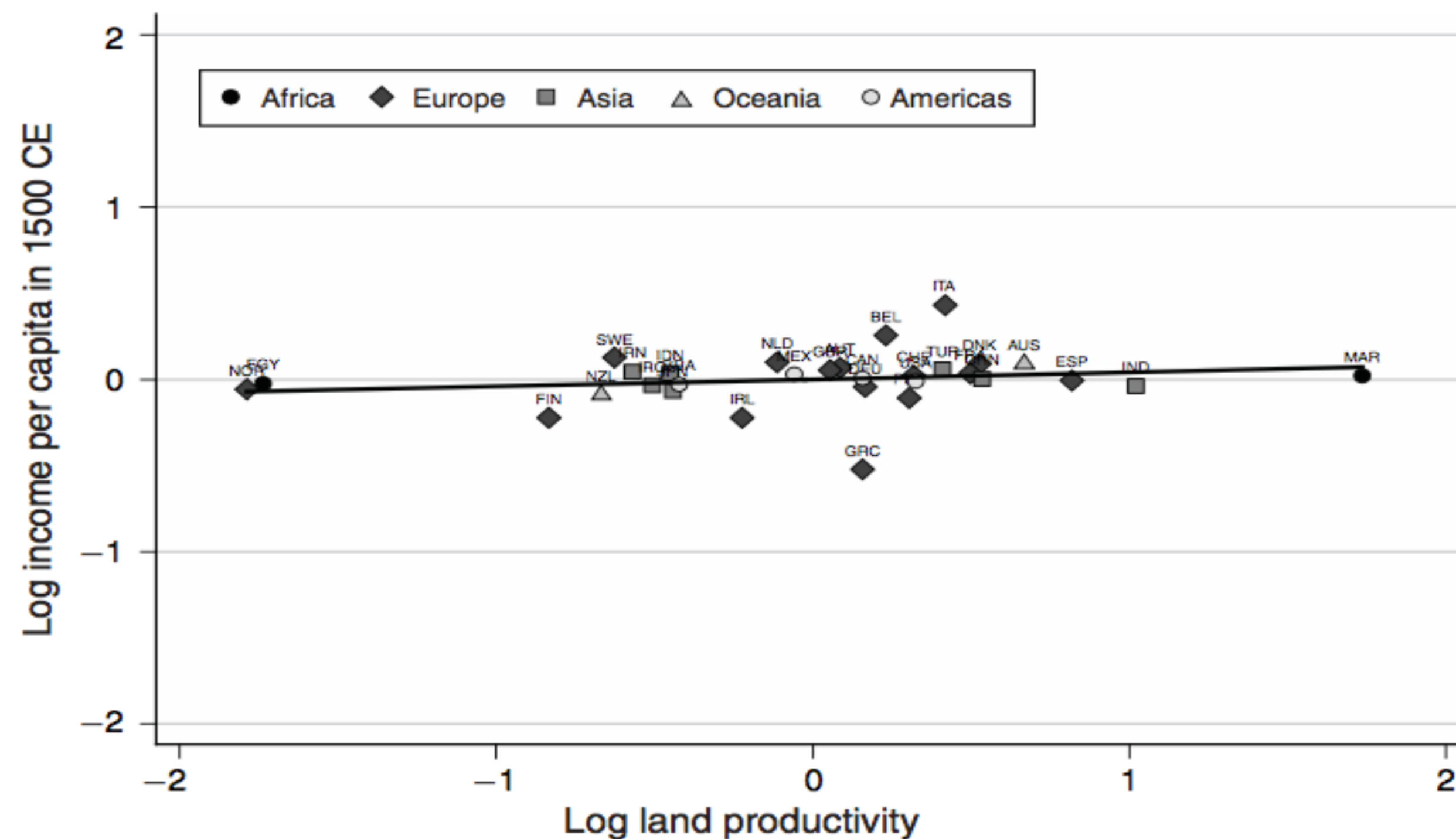


# Character of Malthusian Equilibrium

Panel B. The Partial Effect of Land Productivity on Population Density in 1500 CE



Panel B. The Partial Effect of Land Productivity on Income per Capita in 1500 CE



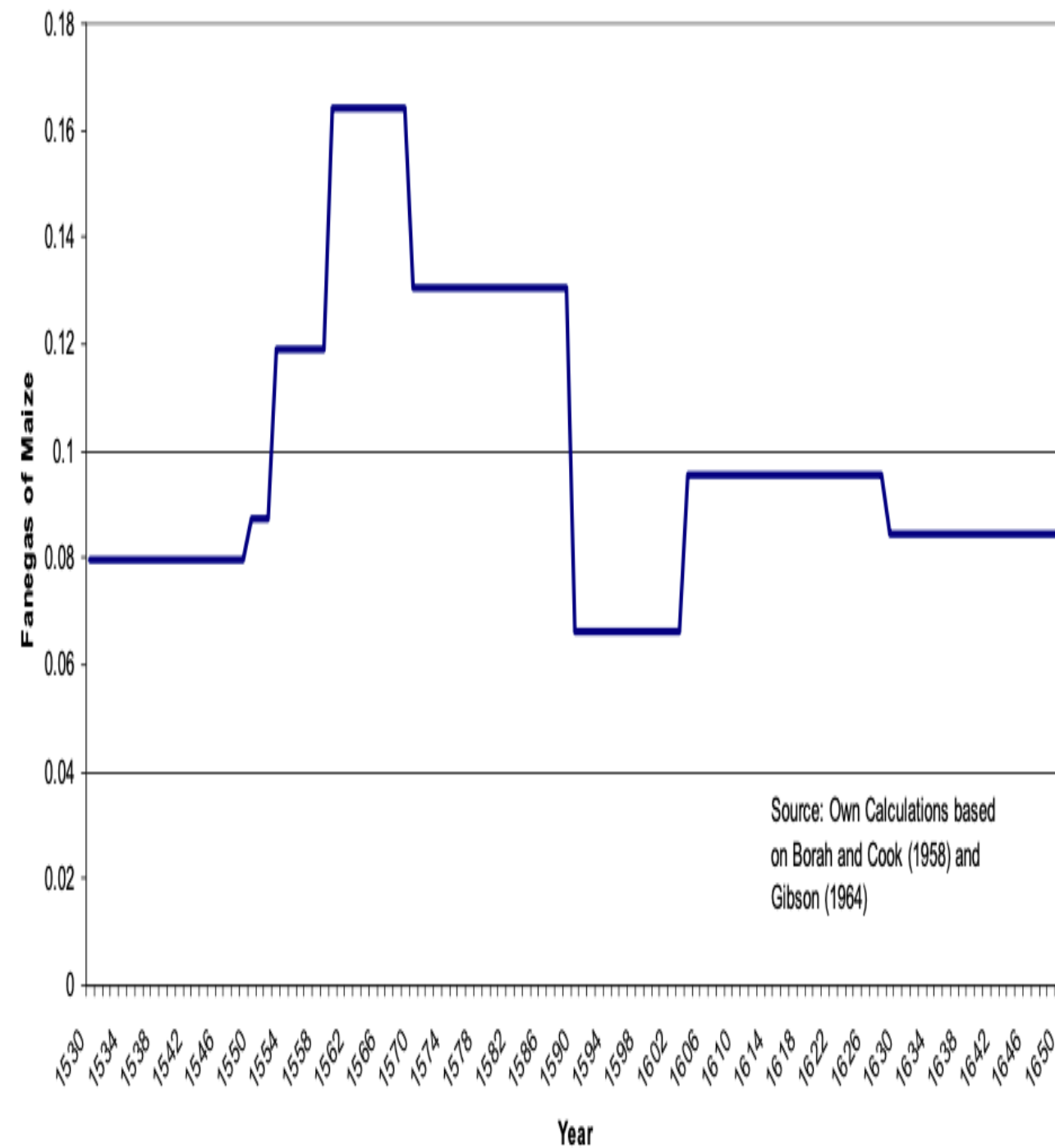


# After the Conquest of Mexico: Unskilled & Textile Workers

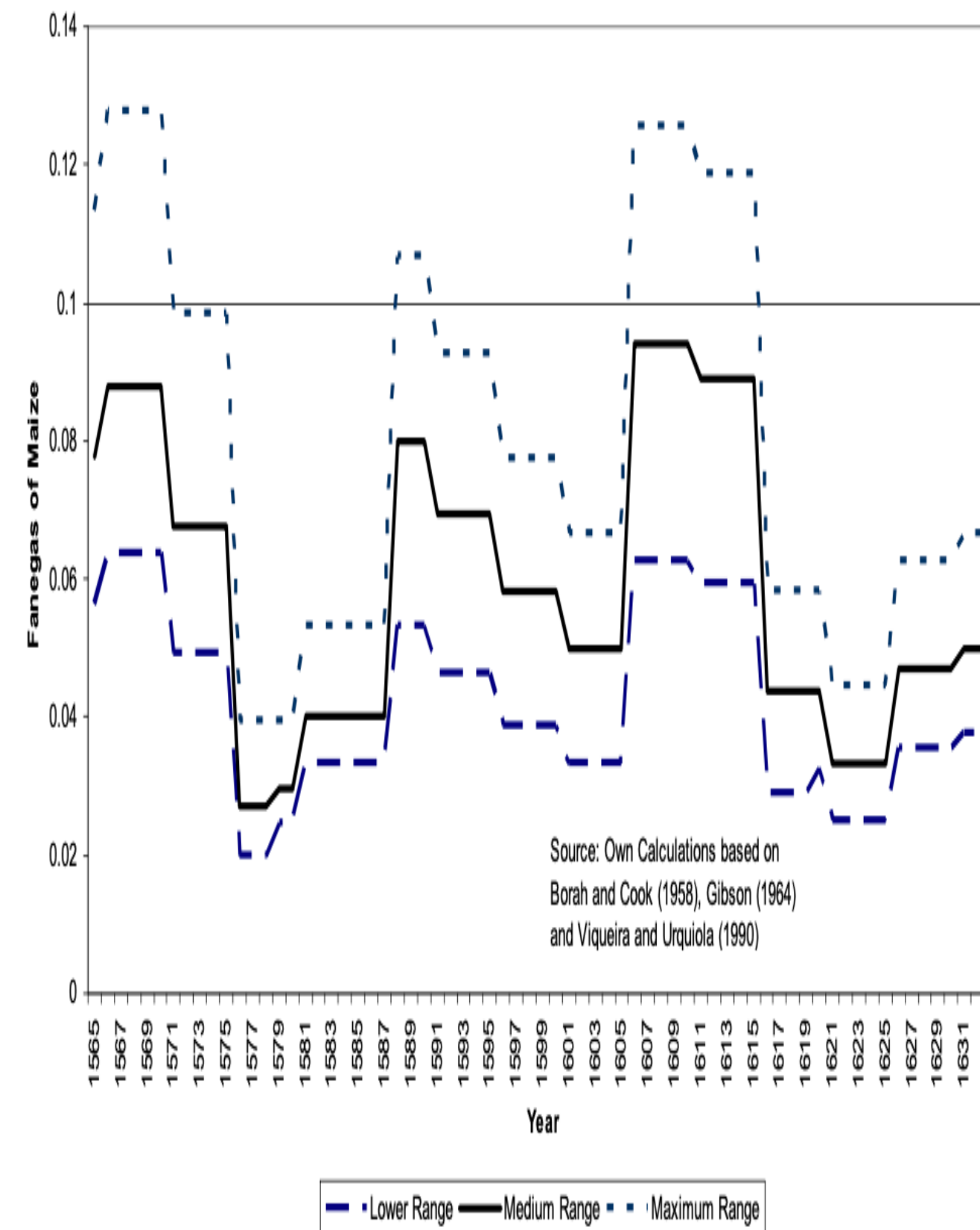
the Repartimiento—a system of central labor allocation:

- Spaniards who wanted labor would petition the Viceroy
- He would allocate Amerindian workers
- He would determine the nominal wage they would be paid.
- Coercion to repress wages
- Centralization kept the landlords' cartel intact.
- (Meanwhile in South America, a massive forced labor system called the *mita*)

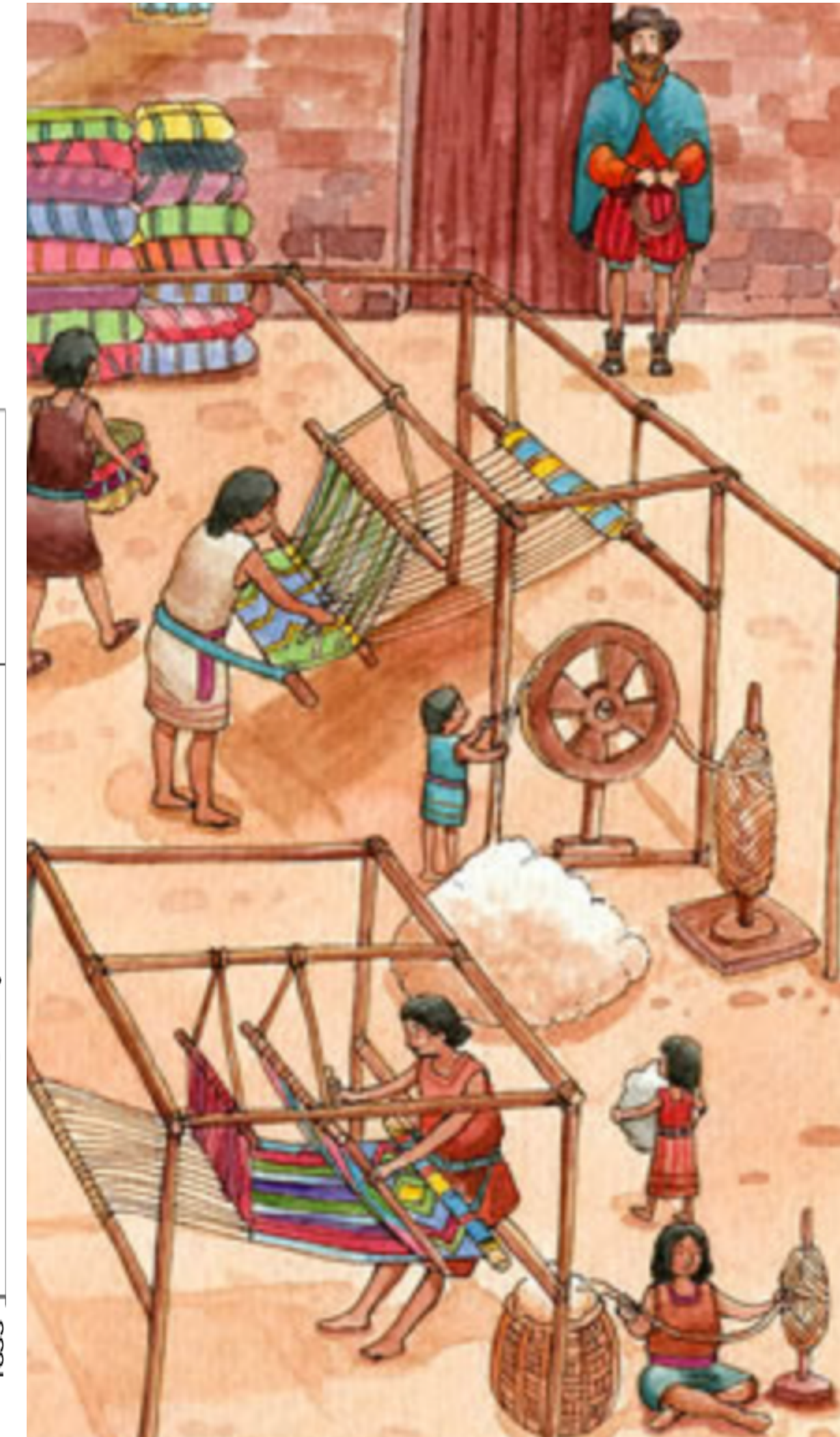
Average Real Daily Wages for Unskilled Workers



Average Real Daily Wages in Obrajes



Source: Acemoglu, Daron, Pablo Querubín and James A. Robinson (2008) "Supply and Demand: Population Decline and Real Wages in Mexico, 1530-1650," Work in Progress.



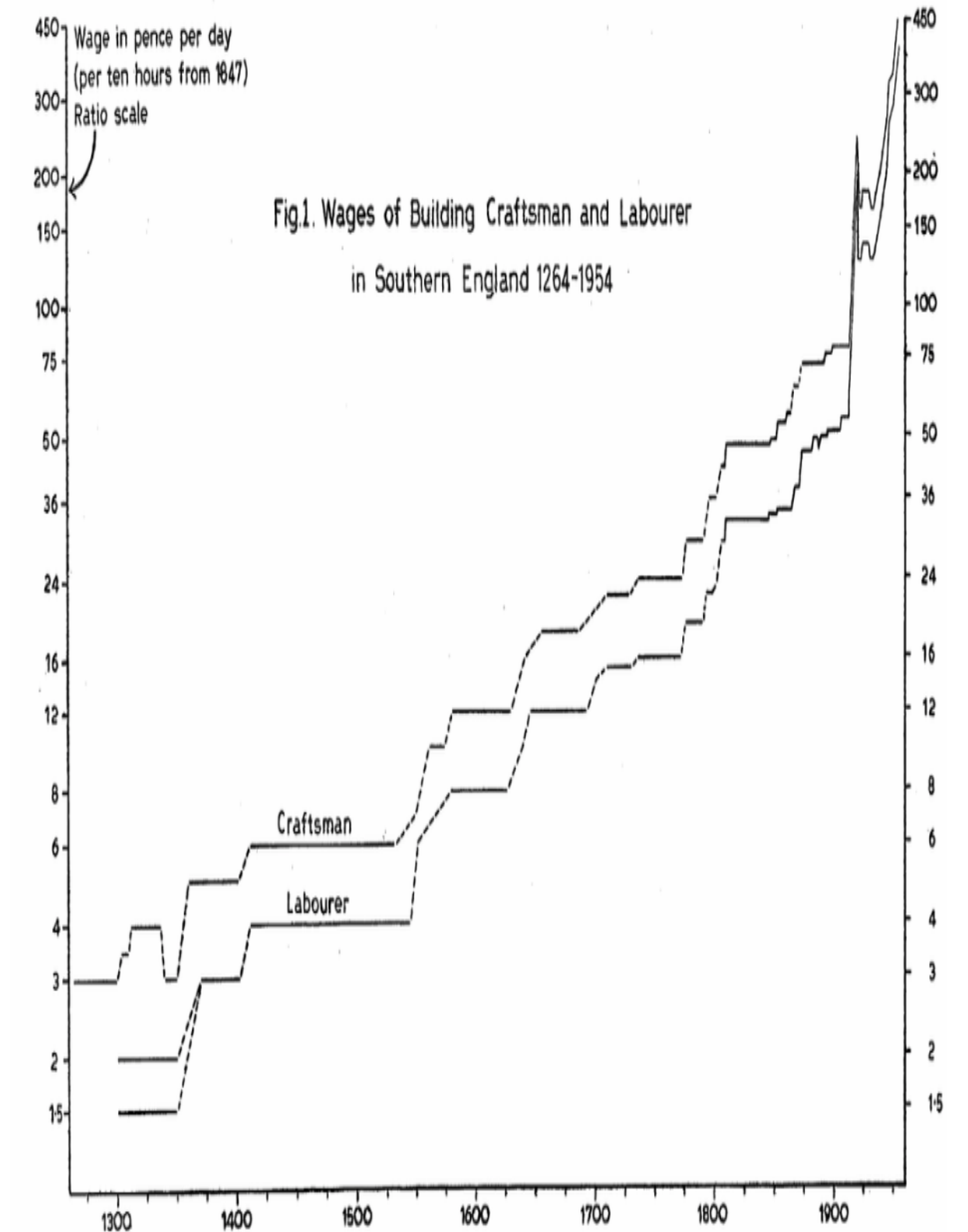


# Malthus and the Black Death

The 1346-48 Bubonic Plague killed off about 1/3 of the population of Europe:

- After the population collapse, real wages eventually increased.
- “Eventually”.
- The government of Edward III tried to stop wages from rising by passing the Statute of Labourers:
  - “Because a great part of the people and especially of the, workmen and servants has now died in that pestilence, some, seeing the straits of the masters and the scarcity of servants, are not willing to serve unless they receive excessive wages ... We, considering the grave inconveniences which might come from the lack especially of ploughmen and such labourers, have ... seen fit to ordain: that every man and woman of our kingdom of England ... shall be bound to serve him who has seen fit so to seek after him; and he shall take only the wages liveries, meed or salary which, in the places where he sought to serve, were accustomed to be paid in the twentieth year of our reign of England, or the five or six common years next preceding ...”
  - “And if a reaper or mower, or other workman or servant, of whatever standing or condition he be, who is retained in the service of any one, do depart from the said service before the end of the term agreed, without permission or reasonable cause, he shall undergo the penalty of imprisonment, and let no one ... moreover, pay or permit to be paid to any one more wages, livery, meed or salary than was customary as has been said...”
- They were only partially able to enforce this, however, and after the Peasants Revolt of 1381, they mostly gave up.

## Real Wages and the Black Death



Source: E. H. Phelps Brown, E.H. and Sheila V. Hopkins (1955) Seven Centuries of Building Wages," *Economica*, 22,195-206.



# William the Conqueror

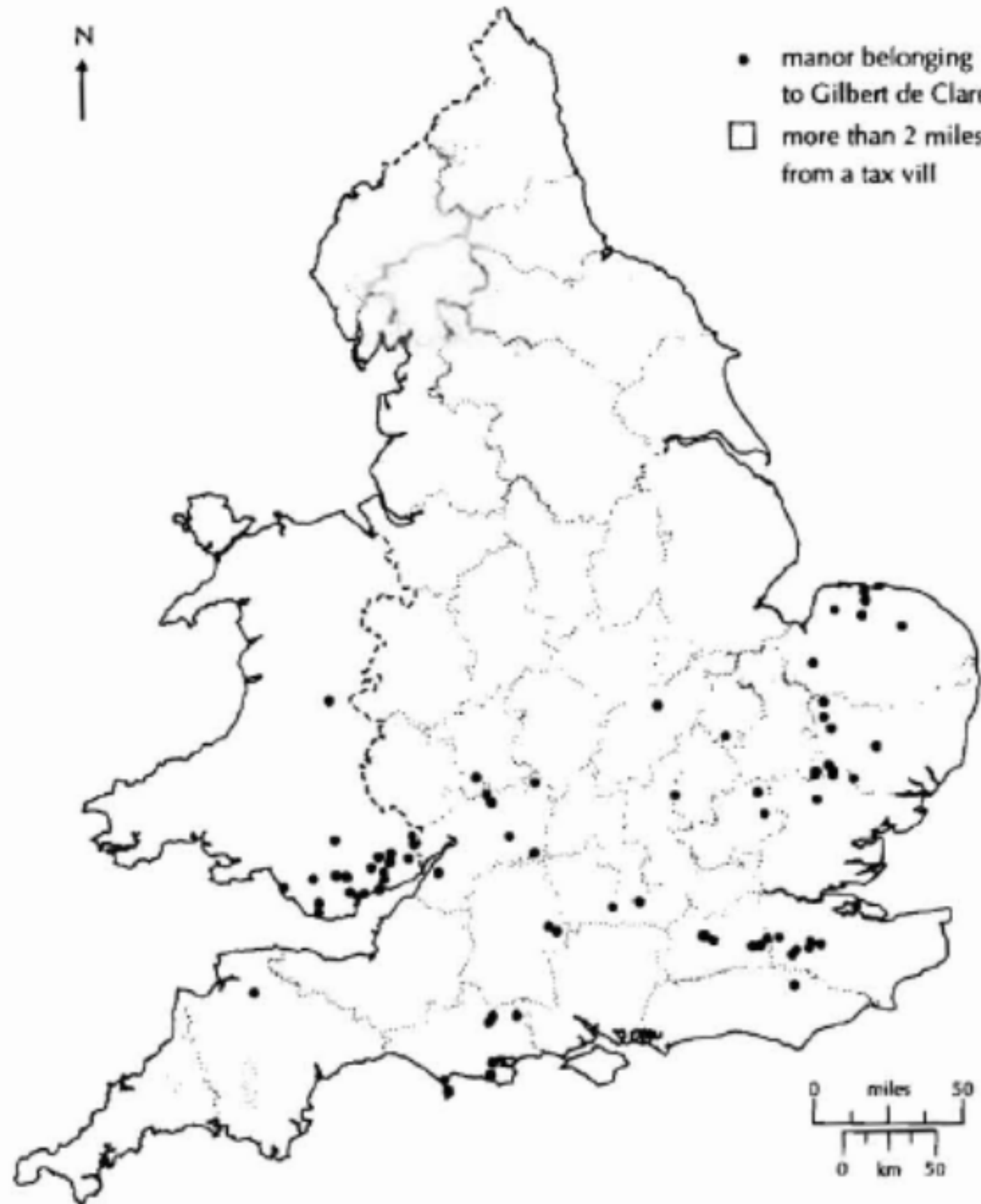
## It's complicated!

- Emma, great-aunt of Guillaume (William: "Steadfast Guardian") "the Conqueror", Duke of Normandy, was the mother of Edward "the Confessor", King of England 1042-1066.
- Edward had grown up in Normandy, where the Normans had protected him from the Danes.
- In 1042 King Harthacnut of Denmark and England died suddenly at the wedding of Thain Tovi the proud and Gytha daughter of Osgood.
- By treaty, Magnus "the Good" was his successor in Denmark.
- Earls Godwin of Wessex, Leofric of the Mark, and Siward of Northumbria decided to support Edward instead of Magnus.
- Edward's older brother Alfred the Ætheling had been captured and blinded by Godwin.
- Then "[Alfred] was looked after by the monks [of Ely], who were fond of him, but soon after he died."
- Godwin's son Harold got himself elected King after Edward's death.
- William was not pleased...





# The de Clare Family



What kept English lords from being able to keep a lid on wages post-1348?

- What was it that allowed the Spanish settlers in Mexico to keep wages so low, when in England after the Black Death the state had been incapable of enforcing the Statute of Laborers and stopping wages from rising?
- The economic historian Bruce Campbell has proposed that this may have been because of the differential organization of landholdings in Britain, which increased competition between landowners for workers after the Black Death.
- After invading England, William the Conqueror rewarded his army by providing them with feudal landholdings.
- In an effort to prevent these nobles from becoming powerful regional warlords who could challenge the king's power, each noble received landholdings scattered across the country
- (The exception was along the Scottish and Welsh borders), where nobles were given large plots for defensive purposes
- This division of landholdings meant that in a given region, there were many landholders in close proximity.
- This created intense competitive pressures for labor, particularly in the wake of the Black Death
- This contrasts to Mexico, where conquistadors were granted vast contiguous tracks of land called encomiendas

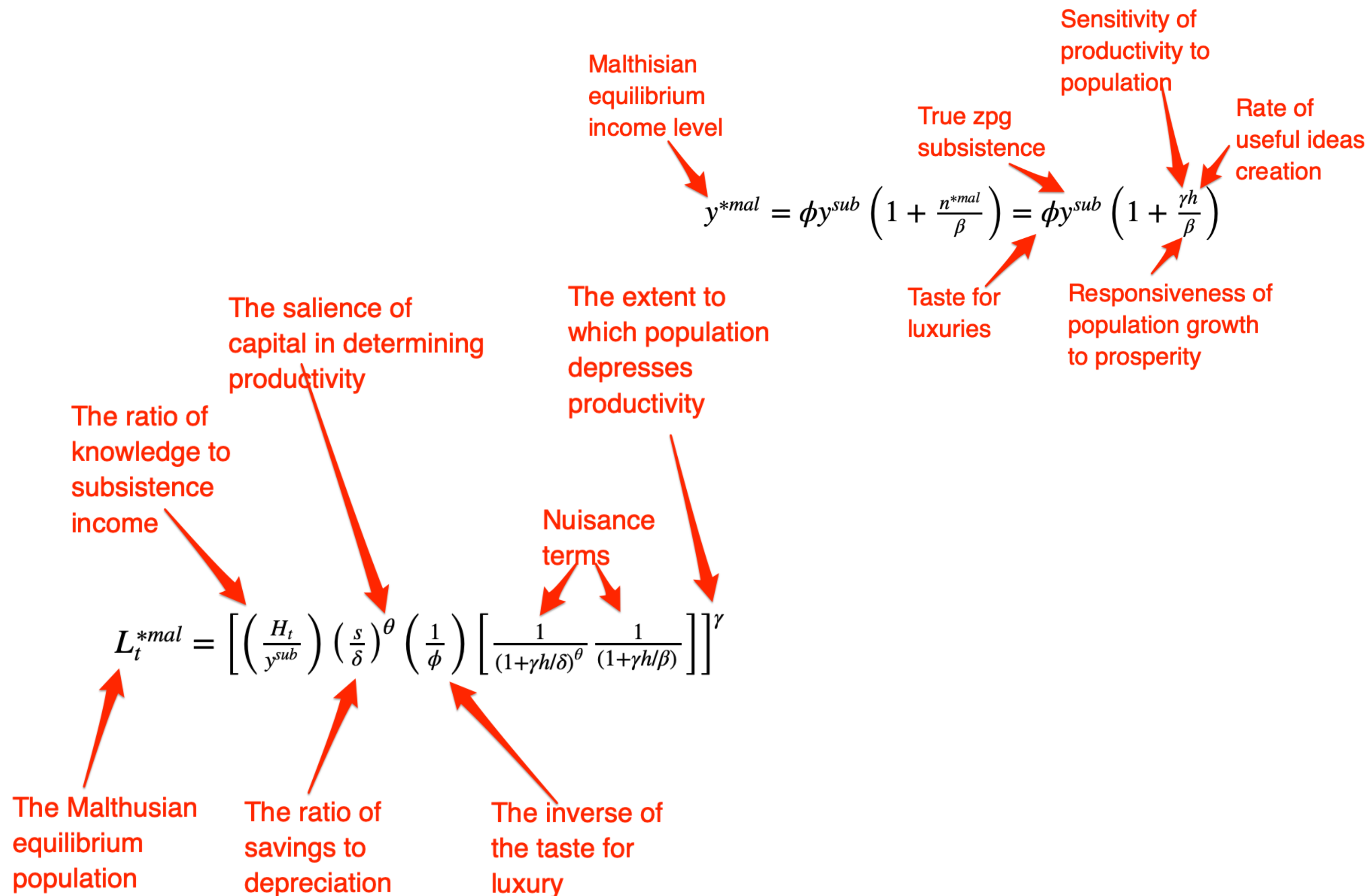


(a) Estate of Gilbert de Clare, earl of Gloucester and Hertford, 1314.



# The Difference Between “Efflorescence” & Growth

- I organize my thoughts about this with the two Malthusian equations, and with their bunch of variables and parameters:  $h$ ,  $\gamma$ ,  $\beta$ ,  $\phi$ ,  $y^{sub}$ ,  $s$ ,  $\delta$ ,  $\theta$ , and  $H$  that together determine  $y^{*mal}$  and  $L^{*mal}$
- Agrarian-Age long run: stable income and productivity
- Agrarian-Age long run: growth of population at rate  $n^{*mal} = \gamma h$
- Agrarian-Age medium run?
- Goldstone—“efflorescences” turn out to be self-limiting in the long run, and vulnerable...





# The Classical Greek Efflorescence

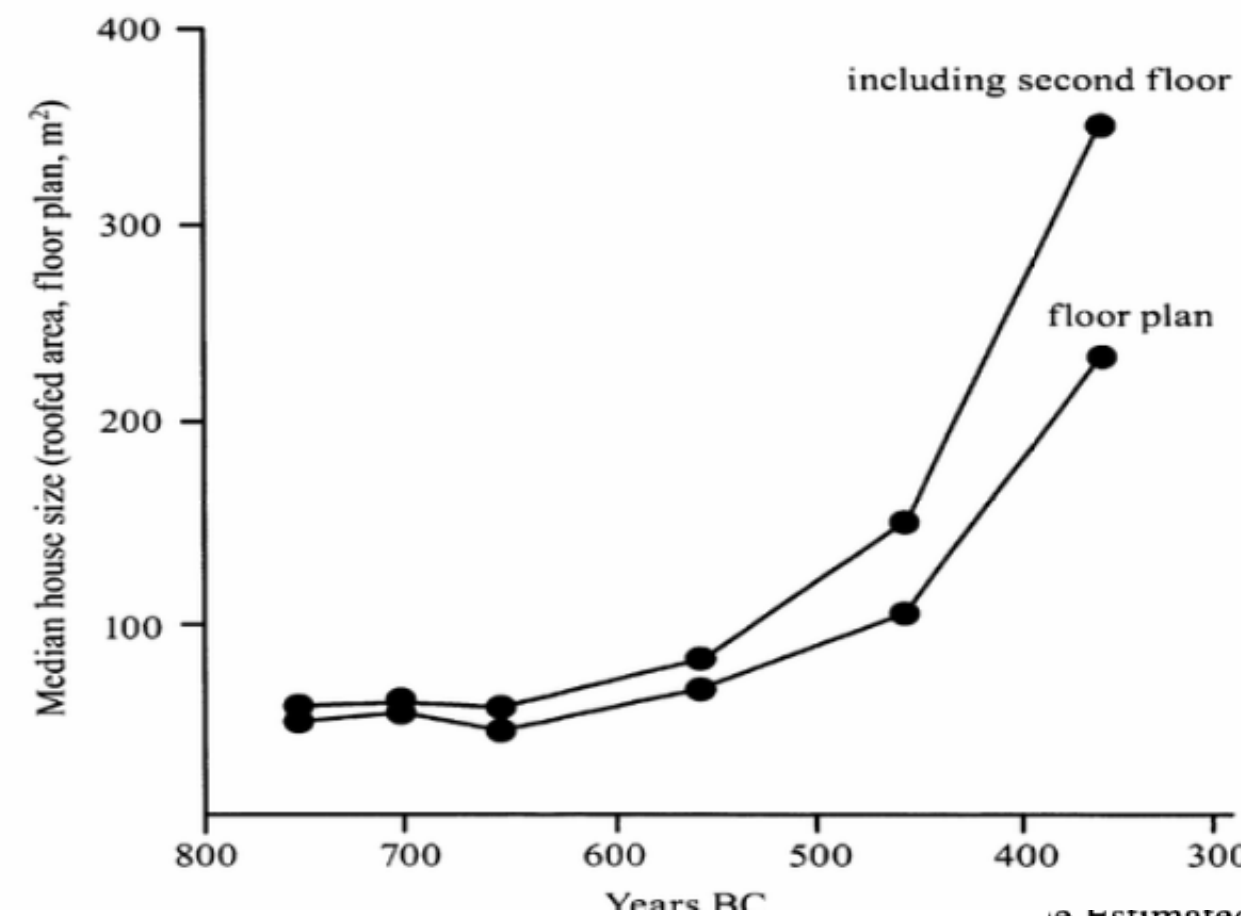
Table 1  
Standard Periodization of Ancient Greek History

Name	Dates
Bronze Age	c. 3000–1200 BC
Late Bronze Age	c. 1600–1200 BC (also known as Mycenaean period)
Early Iron Age	c. 1200–700 BC (also known as Dark Age)
Archaic	c. 700–480 BC
Classical	480–323 BC
Hellenistic	323–30 BC
Early Empire	30 BC–AD 284
Late Empire	AD 284–526
Early Byzantine	AD 526–1081

Source: Morris, Ian (2004) "Economic Growth in Ancient Greece," *Journal of Institutional And Theoretical Economics*, 160, 709-742.

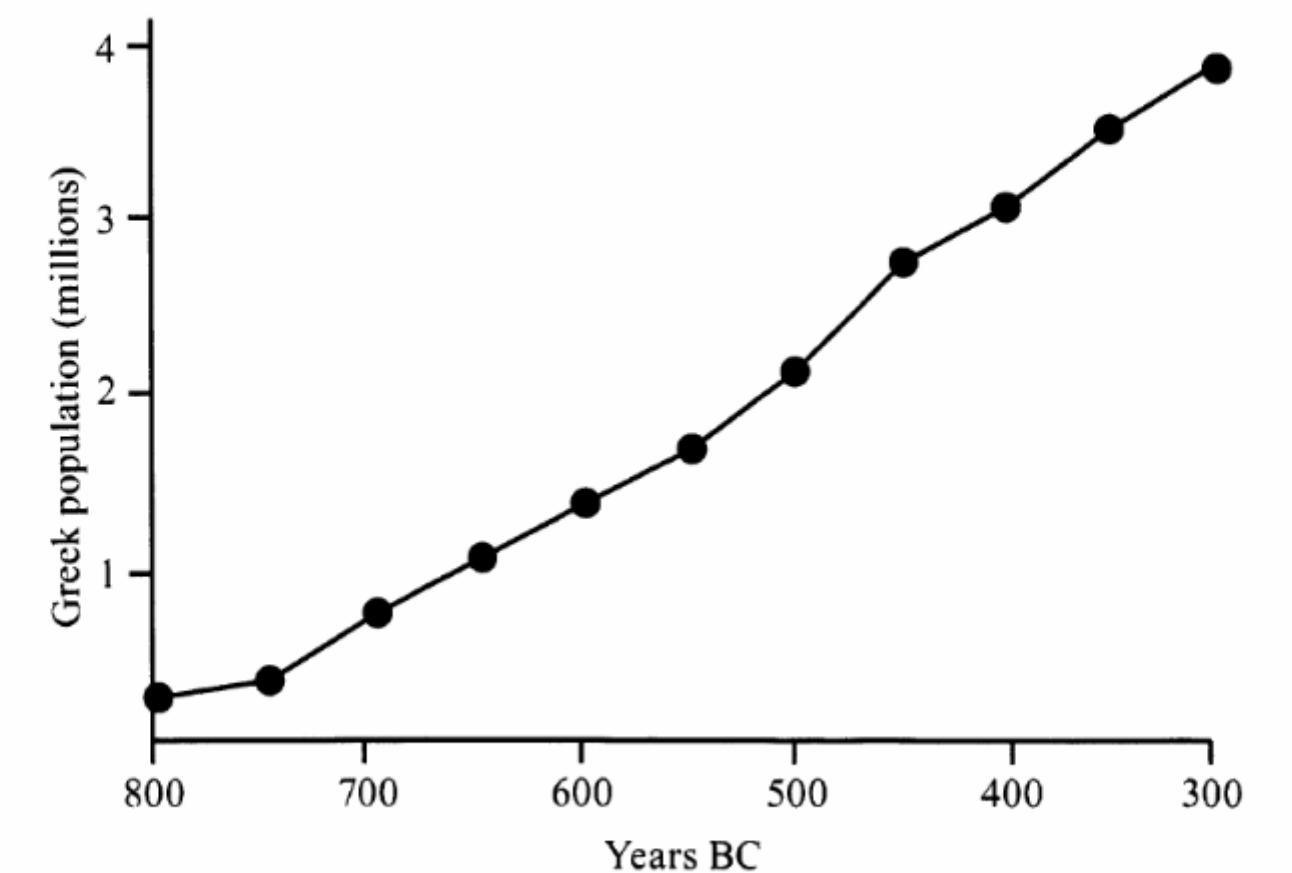
## Houses got Bigger

Figure 7  
Median House Sizes, 800–300 BC (n = 406)



## Population Went Up

Figure 10  
Estimated Population of the Greek World (including the Aegean and western Mediterranean), 800–300 BC



Source: Morris, Ian (2004) "Economic Growth in Ancient Greece," *Journal of Institutional And Theoretical Economics*, 160, 709-742.



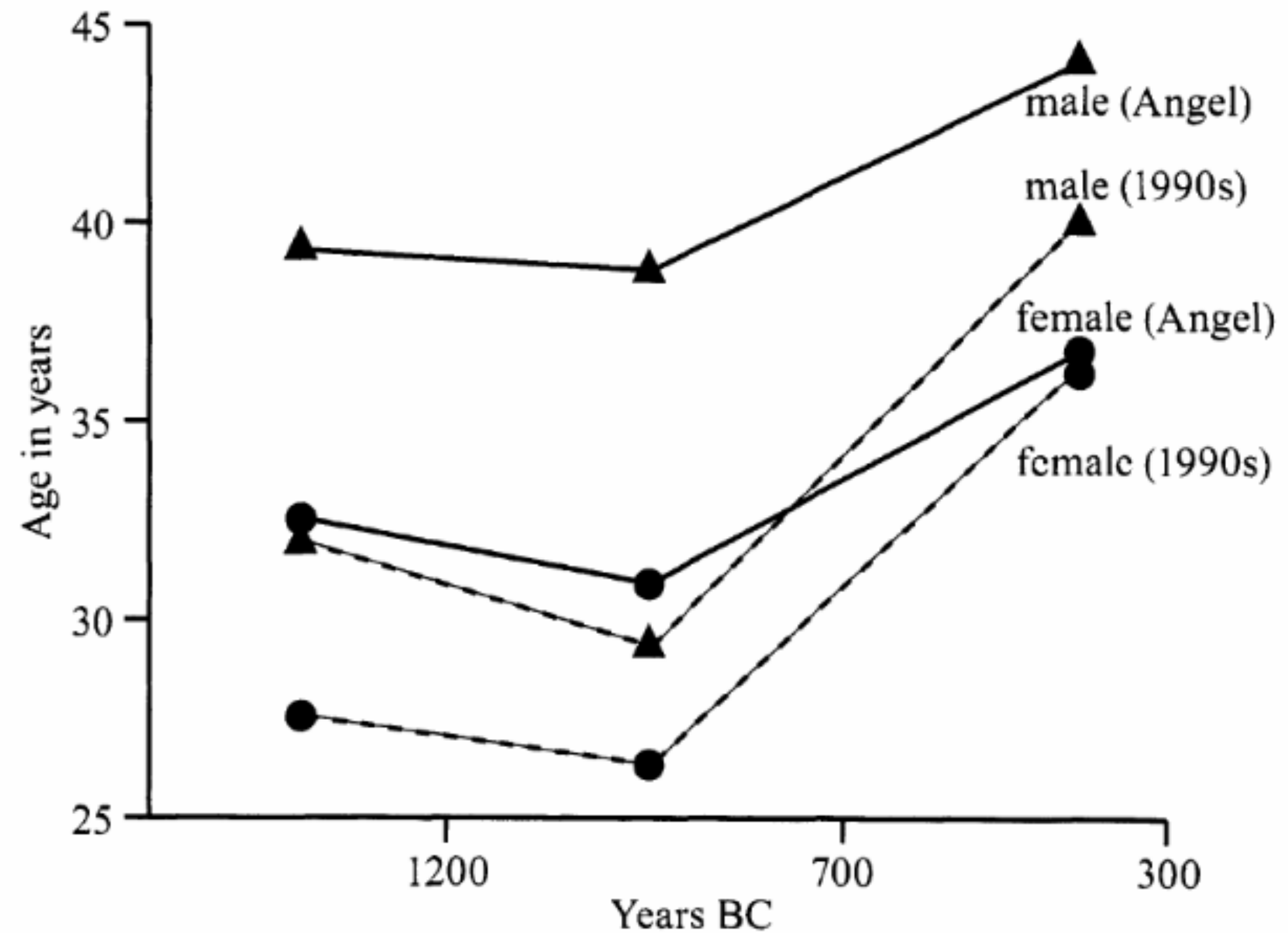
# 3.2.2.1. Peace, Order, & Long Life

Adults have already survived horrific infant mortality:

- Yet your typical adult female skeleton found in the Bronze Age is 27, and in the early Iron Age is 26
- Ditto for males: 33 and 31.
- By the year -400, however, the typical adult-male skeleton is of a 40-year old, and the typical adult-female skeleton is of a 37 year old.
- These are differences that I find astonishing!

Life Expectancy Increased

Figure 2  
Average Adult Ages at Death, 1600–300 BC



The solid lines represent Angel's results, collected in the 1930s–1970s ( $n = 433$ , 294 females), and the broken lines results collected with new techniques in the ( $n = 357$  males, 416 females).



# Odysseus Describes His Departure from Troy

What of my sailing, then, from Troy?  
What of those years of rough adventure,  
weathered under Zeus?

The wind that carried west from Ilion  
brought me to Ísmaros, on the far shore,  
a strongpoint on the coast of the Kikonês.  
I stormed that place and killed the men who  
fought.

Plunder we took, and we enslaved the  
women,  
to make division, equal shares to all—  
but on the spot I told them: ‘Back, and  
quickly!  
Out to sea again!’ My men were mutinous,  
fools, on stores of wine. Sheep after sheep  
they butchered by the surf, and shambling  
cattle,  
feasting,—while fugitives went inland,  
running  
to call to arms the main force of Kikonês.  
This was an army, trained to fight on  
horseback  
or, where the ground required, on foot.  
They came  
with dawn over that terrain like the leaves

and blades of spring. So doom appeared to  
us,  
dark word of Zeus for us, our evil days.

My men stood up and made a fight of it  
backed on the ships, with lances kept in  
play,  
from bright morning through the blaze of  
noon  
holding our beach, although so far  
outnumbered;  
but when the sun passed toward unyoking  
time,  
then the Akhaians, one by one, gave way.

Six benches were left empty in every ship  
that evening when we pulled away from  
death.  
And this new grief we bore with us to sea:  
our precious lives we had, but not our  
friends.  
No ship made sail next day until some  
shipmate  
had raised a cry, three times, for each poor  
ghost  
unfleshed by the Kikonês on that field.





# 3.2.2.2. The Greek City-State

Emerging out of the Iron “Dark Age” of -1200 to -800:

- When the Greek city states emerged they did so with functional systems of governance which provided public goods—security, boundary stones, marketplaces, mediators, dispute resolution.
- This initiated a period of sustained increases in living standards.
- While Ancient Greece did have a period of democracy, it was relative short (less than 200 years) compared to the duration of the polity
  - Remember! Most citizens—slaves, poor citizens who couldn’t afford their tax bill, women—could not participate even in smallholder democracy
- Many *poleis* oligarchies...
- Greek institutions (rules according to which the society was organized) tended to be “extractive”—at least if you were not one of the equals:
  - Economy largely based upon slavery.

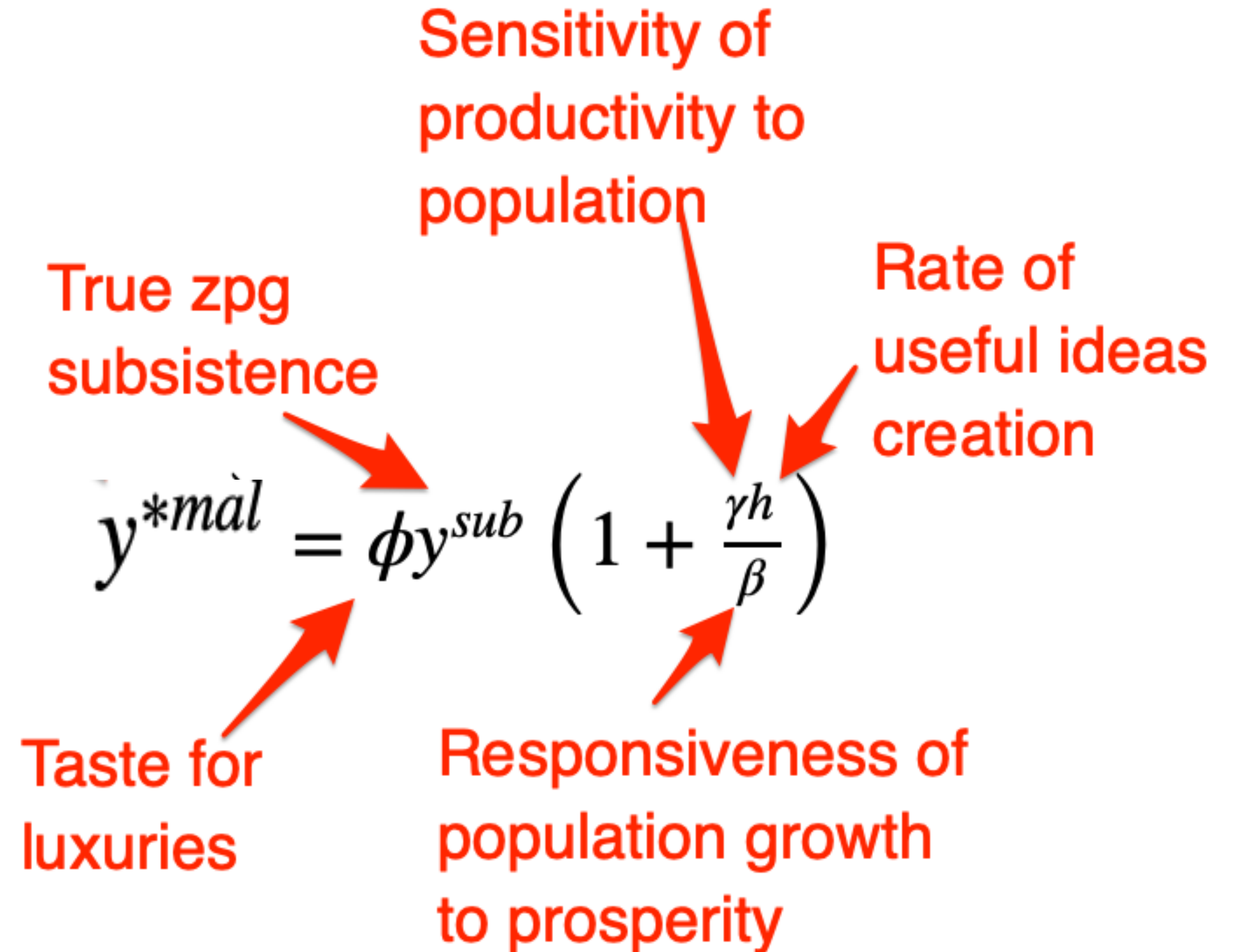




# Standards of Living, Productivity, & Societal Well-Being

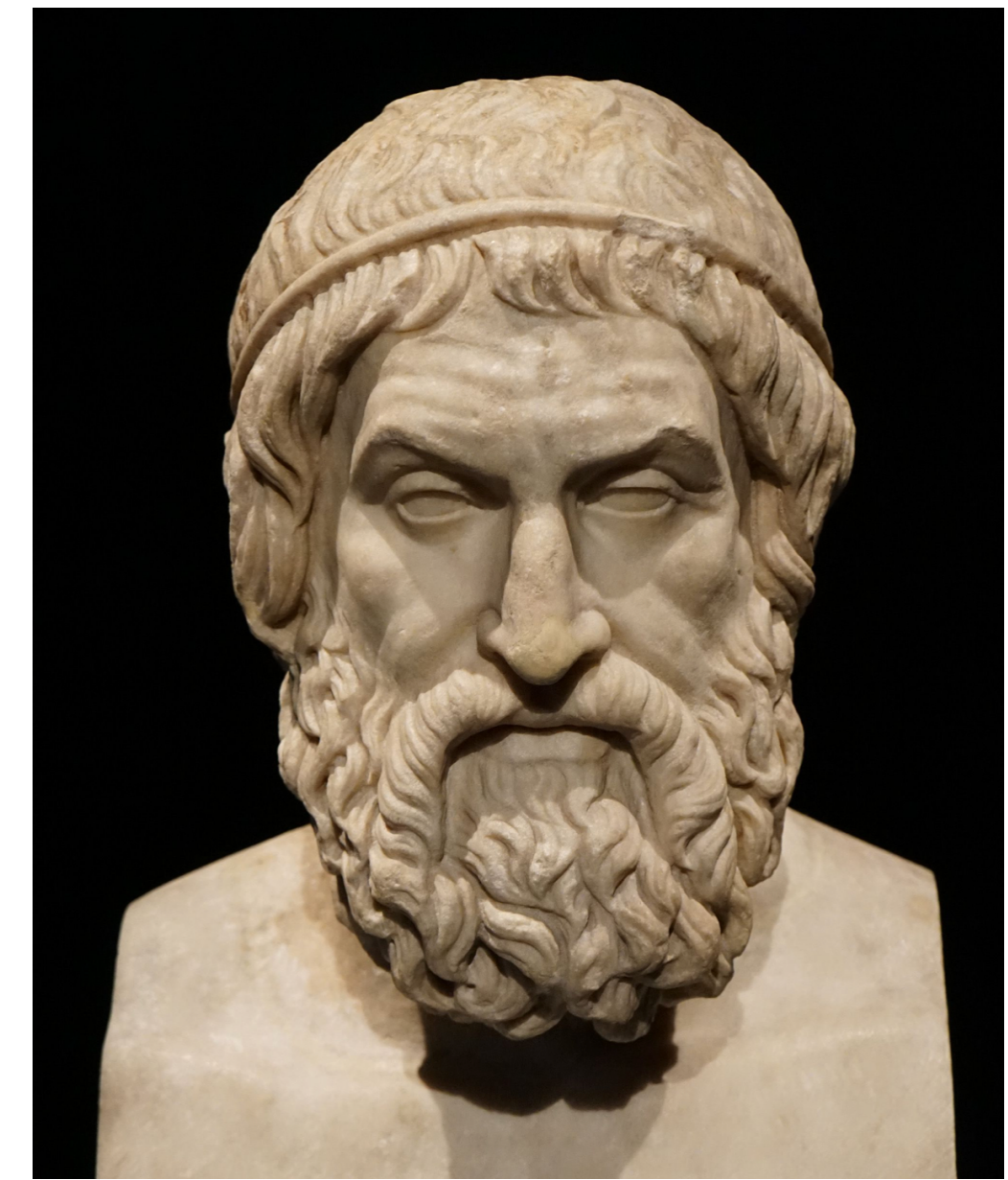
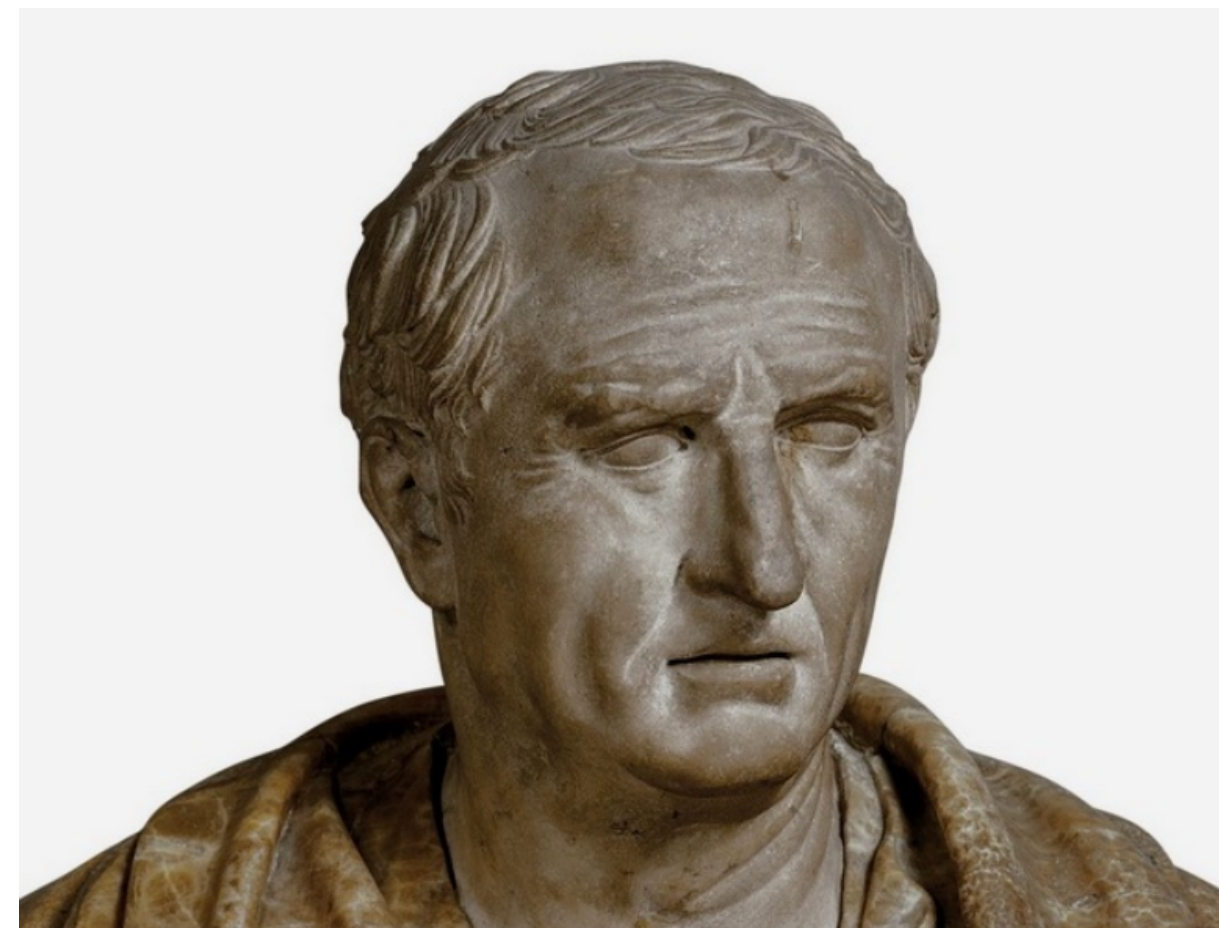
True subsistence-necessities & taste for luxuries are the keys:

- Fewer pirates
- Replacement of raids by battles
- More infanticide (especially female infanticide)
- Cities
- Social hierarchy
- Luxuries to tempt the rich into spending on things other than more bully-boys
- Trade and openness that allow the middle class access to conveniences
- Access to the mental universe of civilization
  
- Bottom line: productivity and average material prosperity up
- Bottom line: societal well-being??





# Supermodel Mnesarete of Thespiai (“Phryne”, Toad) as a Model for Aphrodite, & Other Greek & Roman Worthies...





# The Rise of Rome

## Key Factors:

- **Militarism** (on the part of élites competing for authority)
- **Mobilization** (of the citizenry)
- **Mandate** for the élite to continue conquest, driven by the wide sharing benefits (of conquest)
- **Mass**: incorporation (of conquered communities) into the Roman citizen body
- **Mammoth** military and political expansion after -340, and substantial economic expansion





# Roman Institutions

## Assemblies

- **Centuriate:** 193 centuries on the basis of military organization, weighted toward the rich. Elects the magistrates, declares war and peace
- **Tribal:** After 241 BC, 35 tribes on the basis of geographical location
- **Plebeian:** Non-patricians, run by Tribunes
- **Senate**

## Keys to the Rise of Rome:

- In 510BC, the citizens of Rome overthrew their king, Lucius Tarquinius Superbus, and created a republic.
  - Two consuls who had the job for one year
  - Other magistrates: praetors, aediles, proconsuls
  - Tribunes.
  - Offices were elected, annual, and held by multiple people at the same time
    - This greatly reduced the ability of any one person to consolidate or exploit his power.
- Republic a system of checks and balances which distributed power fairly widely.
- Elite patrician families had far more power, but non-elites plebeians could constrain the power of the elites.
- The *nobiles*

## Political-Military institutions:

- Legions
  - Phalanx
  - Manipular
  - Marian
  - Imperial
- Imperium
- Provinciae
- Proconsuls and propraetors



# From Republic to Empire

## Political Transition:

- The expansion of Rome's conquests created inequality and increasing political instability.
- There were calls for the redistribution of land and power.
- For example, Plebeian Tribune Tiberius Gracchus started to develop very 'populist' political platforms which threatened the senatorial elites.
- The culmination of this was civil war, the dictatorship of Julius Caesar, and finally the creation of the Empire under Augustus.
  - First the *principate*
  - Then the *dominate*
- Augustus reformed the army, removing it as a bastion of plebeian power.
- His successor Tiberius stripped the assemblies of powers and gave them to the senate—and then neutered the senate
- A semi-hereditary monarchy replaced the Republic:
  - “May good success attend the Roman senate and people and myself. I hereby adopt as my son Marcus Ulpius Nerva Traianus...”
- This was a move towards more “extractive” political institutions and though it stabilized things for awhile, there was an eventual movement towards even more extractive economic institutions



# Roman Zenith

Always Scribble, Scribble, Scribble! Eh! Mr. Gibbon?:

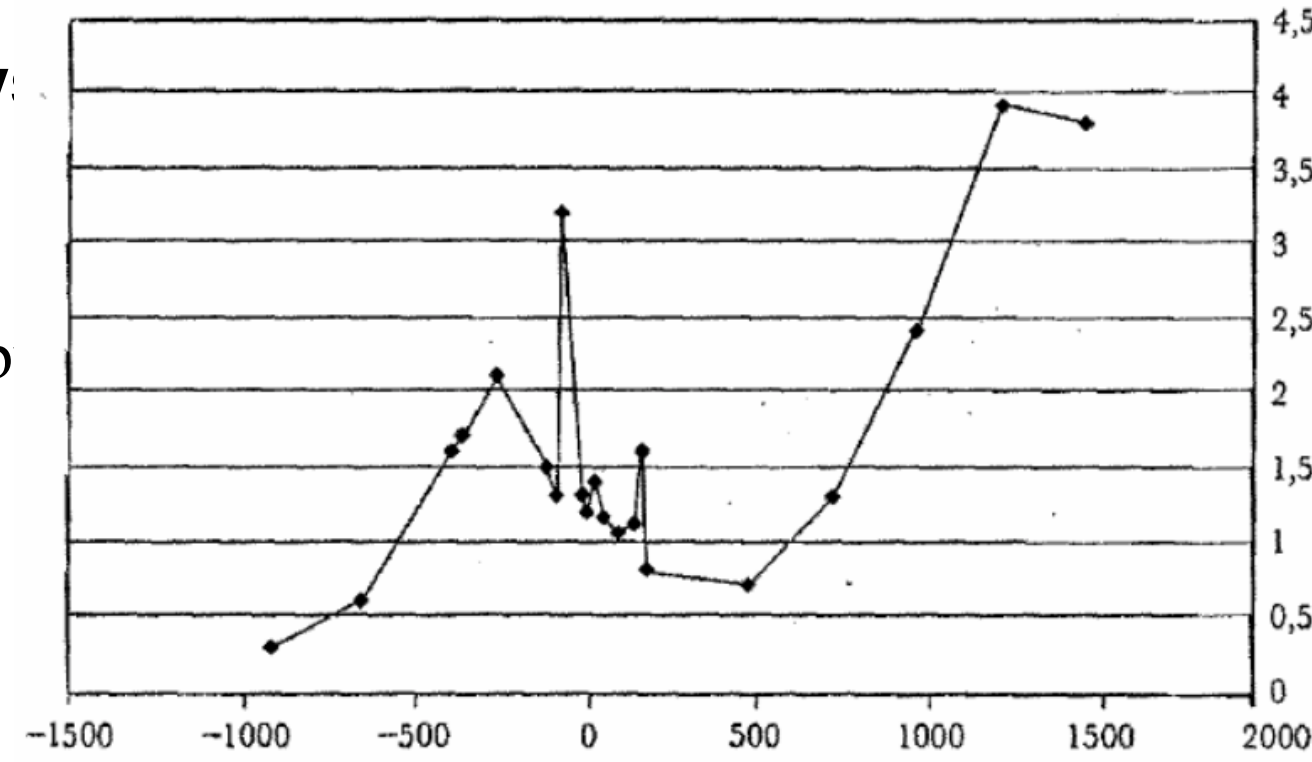
- Beste, *Memorials*: “The Duke of Gloucester, brother of King George III, permitted Mr. Gibbon to present to him the first volume of *The History of the Decline and Fall of the Roman Empire*. When the second volume of that work appeared, it was quite in order that it should be presented to His Royal Highness in like manner. The prince received the author with much good nature and affability, saying to him, as he laid the quarto on the table,
- ‘Another damned thick, square book! Always, scribble, scribble, scribble! Eh! Mr. Gibbon?’ ...



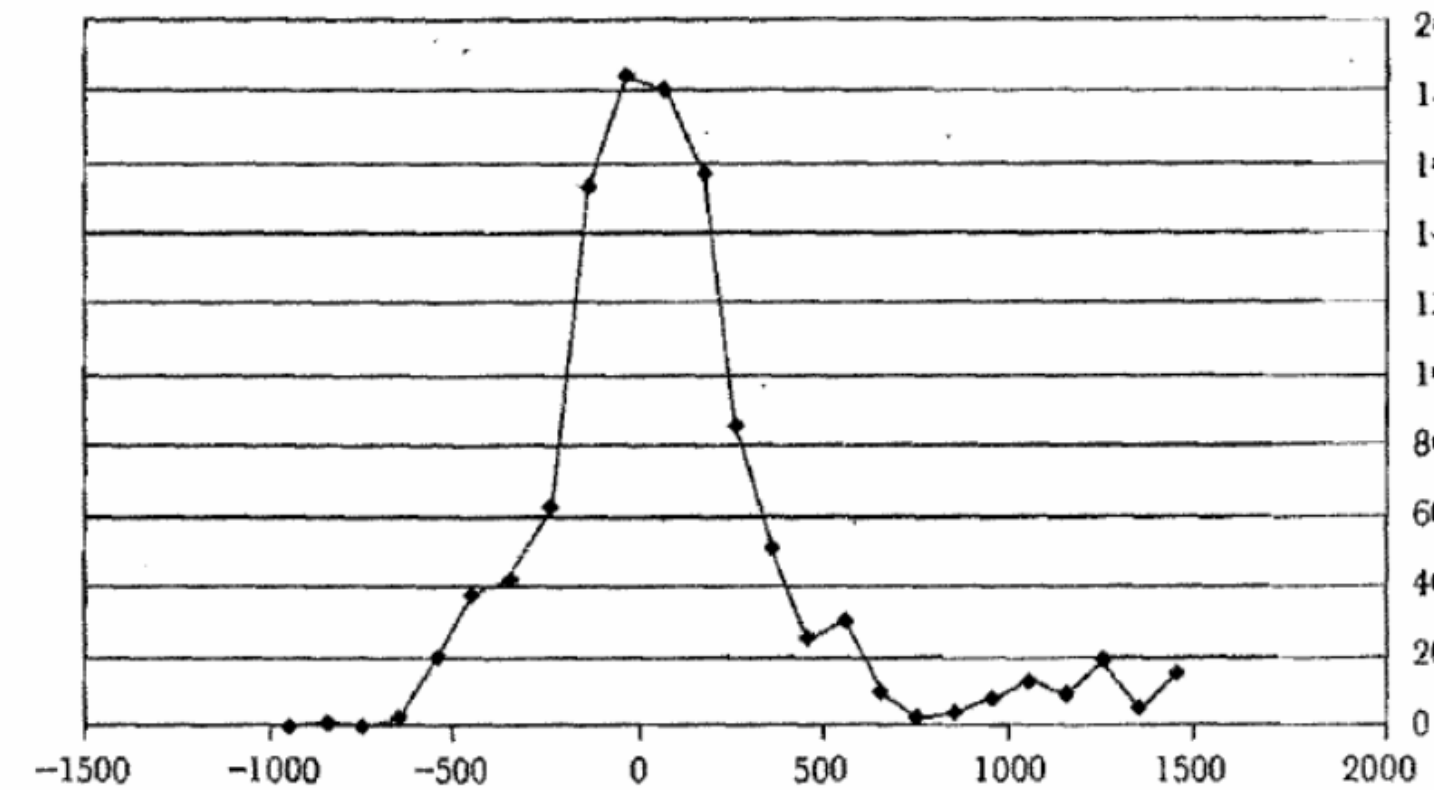
# Measuring Roman Efflorescence

There are many interesting ways to track economic expansion:

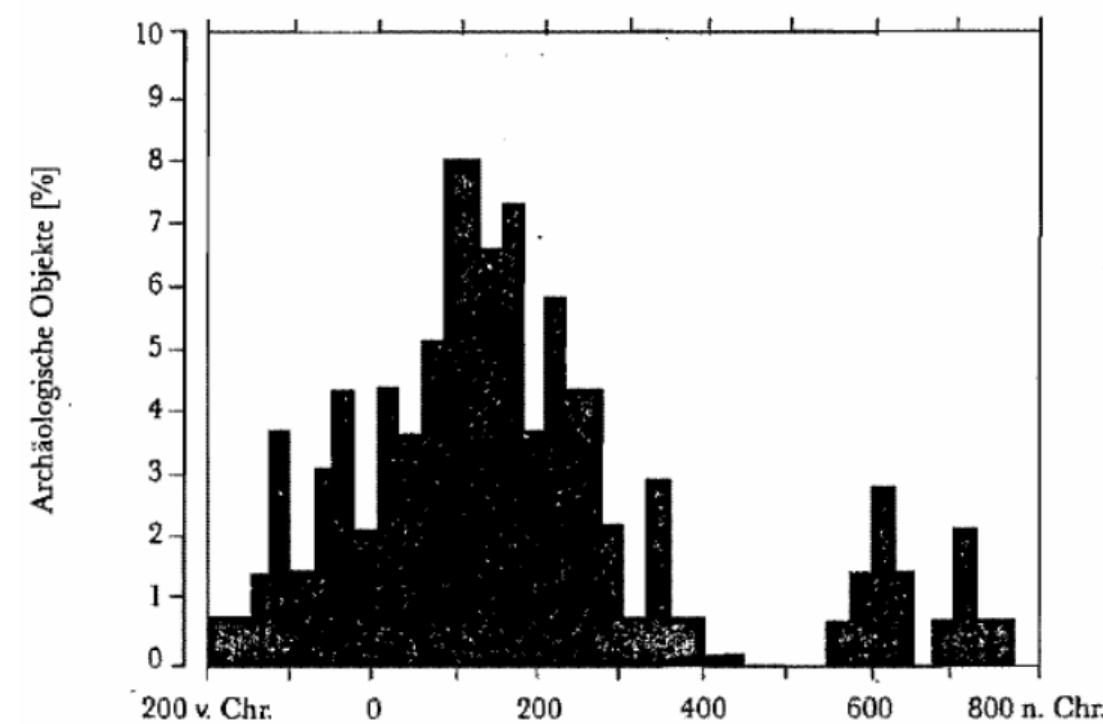
- Shipwrecks indicate trade, but they also track the movement of goods by fiat. For example, the citizens of Rome were kept happy by the free distribution of bread after 58BC. This was later extended to olive oil and even wine. This had to be shipped (mostly from Egypt and North Africa).
- The Romans also moved around taxes levied in the provinces and supplied their troops. Some argue that 2/3 of all the 'trade' was actually the state moving stuff around.
- For Roman citizens, economic institutions were quite good. However, the Italian economy was based on slavery (about 35% of the population of Italy were slaves at the time of the Emperor Augustus). There was little technological change.



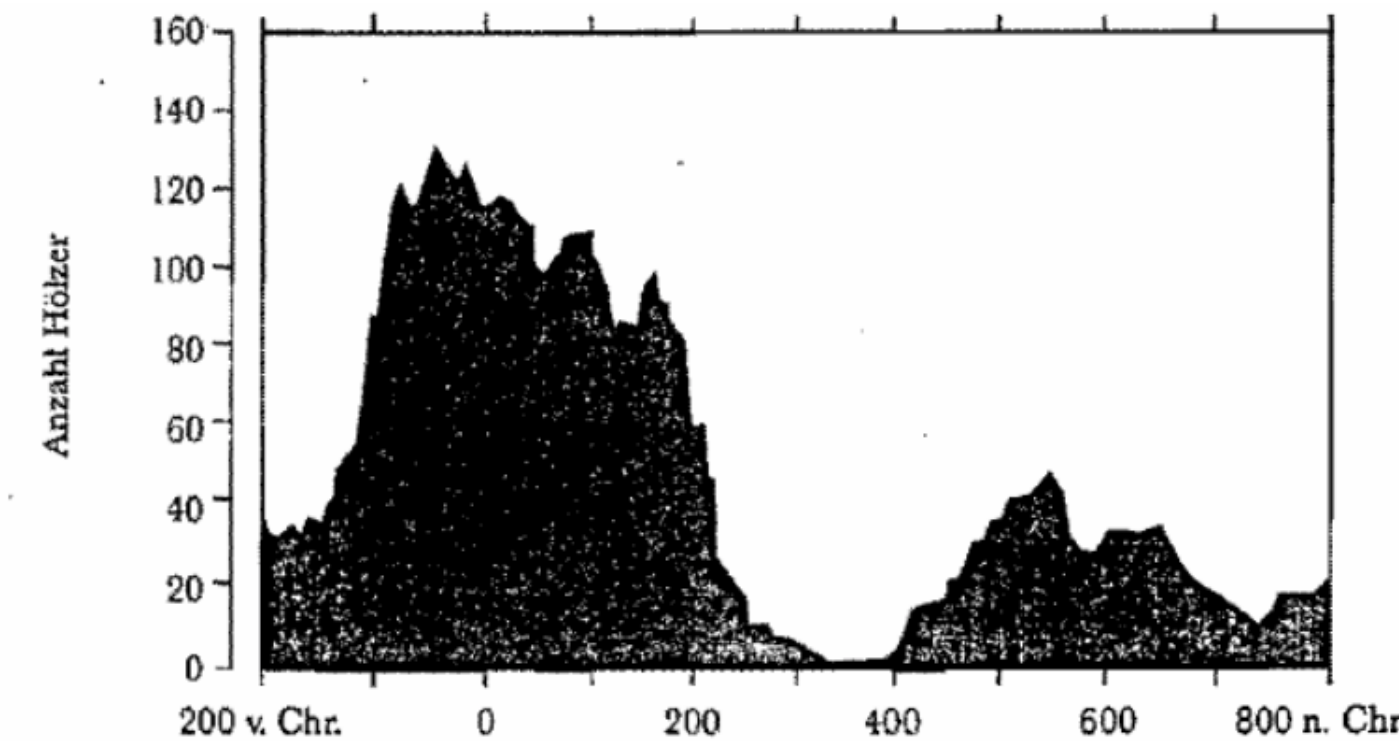
Graph 2: Lead pollution in Greenland ice cores<sup>22</sup>



Graph 1: dated shipwrecks (from De Catalajà 2005)



Graph 4: archaeological finds in western Germany (Trier laboratory)



Graph 3: dated wood remains from western Germany (Trier laboratory)





# The Five Good Emperors

## Nerva-Trajan-Hadrian-Antonius Pius-Marcus Aurelius:

- “If a man were called to fix the period in the history of the world, during which the condition of the human race was most happy and prosperous, he would, without hesitation, name that which elapsed from the death of Domitian to the accession of Commodus.
  - The vast extent of the Roman empire was governed by absolute power, under the guidance of virtue and wisdom.
  - The armies were restrained by the firm but gentle hand of four successive emperors, whose characters and authority commanded involuntary respect.
  - The forms of the civil administration were carefully preserved by Nerva, Trajan, Hadrian, and the Antonines, who delighted in the image of liberty, and were pleased with considering themselves as the accountable ministers of the laws.
  - Such princes deserved the honor of restoring the republic, had the Romans of their days been capable of enjoying a rational freedom.
- The labors of these monarchs were overpaid by
  - the immense reward that inseparably waited on their success;
  - by the honest pride of virtue, and
  - by the exquisite delight of beholding the general happiness of which they were the authors...



# Ælius Aristides

## The Roman Oration:

- Whatever the seasons make grow and whatever countries and rivers and lakes and arts of Hellenes and non-Hellenes produce are brought from every land and sea, so that if one would look at all these things, he must needs behold them either by visiting the entire civilized world or by coming to this city. For whatever is grown and made among each people cannot fail to be here at all times and in abundance. And here the the merchant vessels come carrying these many products from all region in every season and even at every equinox, so that the city appears a kind of common emporium of the world.
- Cargoes from India and, if you will, even from Arabia the Blest one can see in such numbers as to surmise that in those lands the trees will have been stripped bare and that the inhabitants of these lands, if they need anything, must come here and beg for a share of their own. Again one can see Babylonian garments and ornaments from the barbarian country beyond arriving in greater quantity and with more ease than if shippers from Naxos or from Cythnos, bearing something from those islands, had but to enter the port of Athens. Your farms are Egypt, Sicily and the civilized part of Africa.
- Arrivals and departures by sea never cease, so that the wonder is not that the harbor has insufficient space for merchant vessels, but that even the sea has enough, if it really does.
- And just as Hesiod said about the ends of the Ocean, that there is a common channel where all waters have one source and destination, so there is a common channel to Rome and all meet here, trade, shipping, agriculture, metallurgy, all the arts and crafts that are or ever have been, all the things that are engendered or or grow from the earth. And whatever one does not see here neither did nor does exist. And so it is not easy to which is greater, the superiority of this city in respect to the cities that now are or the superiority of this city respect to the empires that ever were...



# Eurasia at Its Classical Apogee





# Han Empire

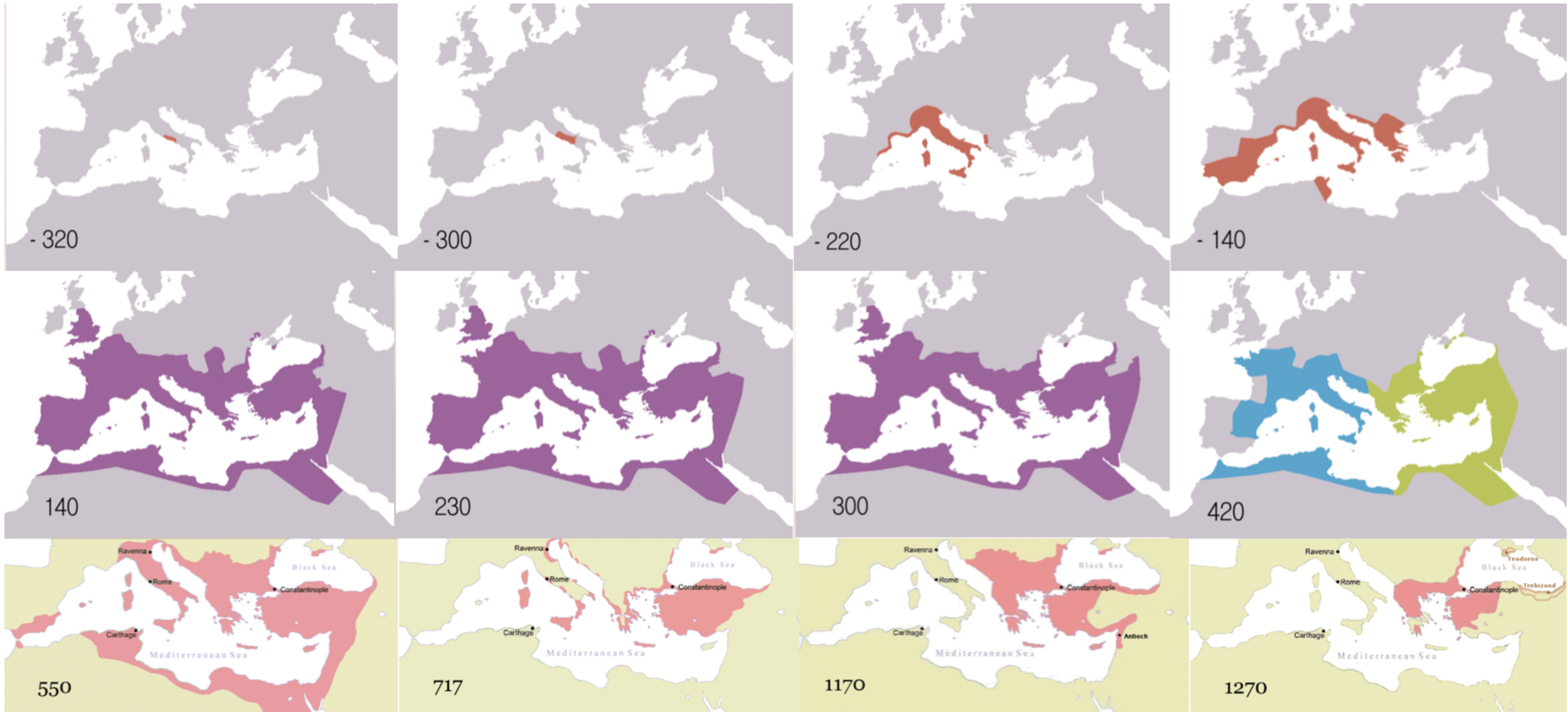
## Han Dynasty (-202 to 220)

- Western Han
- Eastern Han
- Protectorate of the Western Regions
- Daoist Rebellions: Yellow Turbans & Five-Pecks-of-Rice
- Generals vs. eunuchs
- Cao Wei, Eastern Wu, & Shu Han
- Three Kingdoms—Six Dynasties—Sixteen Kingdoms—Sui





# Rome's Rise & Fall, -320 to 1270





# The Fall of Rome (& Others)

## The Fall of Rome:

- The demands of the empire for revenue and of the upper class for resources remain the same
- Three great plagues:
  - Antonine Plague (smallpox?): Antonine  $\Rightarrow$  Severan dynasty
  - Plague of St. Cyrian (Ebola-like?):
    - Things fall completely apart, then Diocletian
    - Between Philip the Arab and Diocletian, 18 emperors in 35 years, plus two breakaways; 12 of the 18 were assassinated
  - Plague of Justinian (Bubonic): Flavius Apion...



$$y^{*mal} = \phi y^{sub} (1 + \gamma h / \beta)$$

$$\frac{L_t^{*mal}}{R} = \left[ \left( \frac{H_t}{y^{sub}} \right) \left( \frac{s}{\delta} \right)^\theta \left( \frac{1}{\phi} \right) \left[ \frac{1}{(1 + \gamma h / \delta)^\theta} \frac{1}{(1 + \gamma h / \beta)} \right] \right]^\gamma$$



# The Crisis of the Middle 200s

Julio-Claudian, Flavian, Antonine, Severan Dynasties:

- Antonine Dynasty 96-193
  - Plague 165-180
- Interregnum: Pertinax, Pescennius Niger, Clodius Albinus, Didius Julianus
- Severan Dynasty 193 (196)-235
- Then: 27 emperors, 35 claimants in 50 years; loss of Dacia and the Ten-Canton Fields; sacking of Athens, Ephesus, and Antioch
- The economy is falling apart...
- The exploitative screws are being tightened...
- The beginnings of commendation and serfdom...
- Perhaps the miracle was that the crisis was of the mid-200s rather than the late-100s...





# The Later Roman Empire

## How does it compare to the expanding Roman Republic?

- **Militarism:** in striking contrast to earlier days, a successful general is a threat to the emperor. Eighteen emperors in 35 years between Philip the Arab and Diocletian
- **Mobilization:** In order to extract resources from a smaller population, the people must be disarmed rather than mobilized.
- **Mandate:** Absent: the smaller pool of benefits needs to be hoarded for those with connections, not shared.
- **Mass:** Not achieved—you can join the Goths: you cannot join the Roman upper class unless you know someone...



# The Later Roman Empire

## Peter Sarris on Justinian I in 542:

- Writing to his Praetorian Prefect concerning the army—trained and equipped and paid for by the Roman State to control the barbarians and to "increase the state." Peter Sarris reports in his *Economy and Society in the Age of Justinian*, upset that:
- Certain individuals had been daring to draw away soldiers and *foederati* from their duties, occupying such troops entirely with their own private business.... The emperor... prohibit[ed] such individuals from drawing to themselves or diverting troops... having them in their household... on their property or estates.... Any individual who, after thirty days, continues to employ soldiers to meet his private needs and does not return them to their units will face confiscation of property... "and those soldiers and *fioderati* who remain in *paramonar* attendance upon them... will not only be deprived of their rank, but also undergo punishments up to and including capital punishment.”



# The Later Roman Empire II

**One of Flavius's tenants and debtors, Anoup, wrote:**

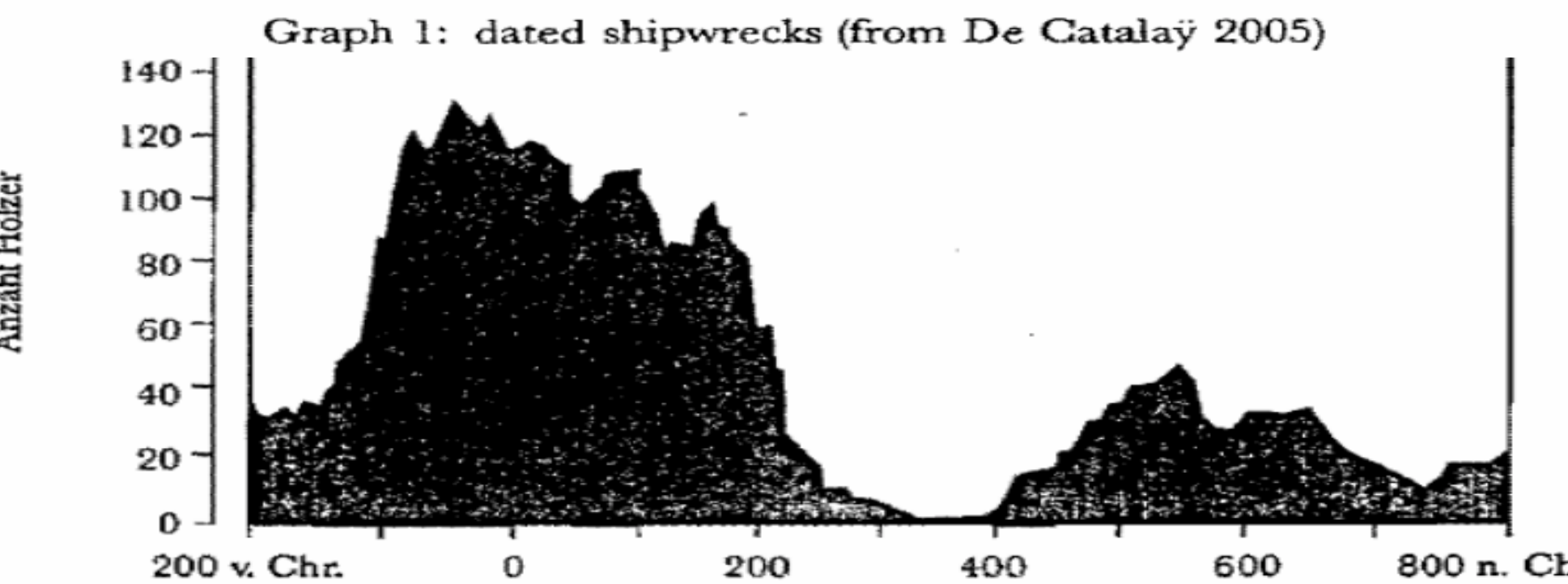
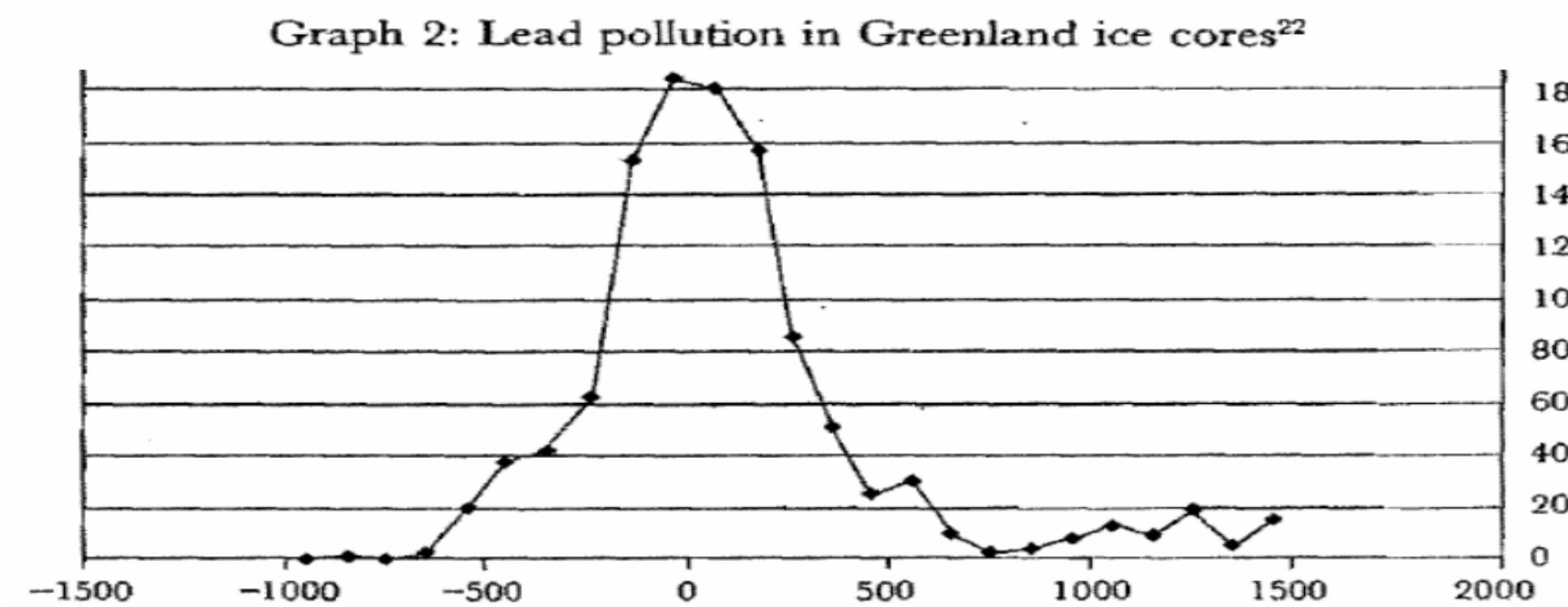
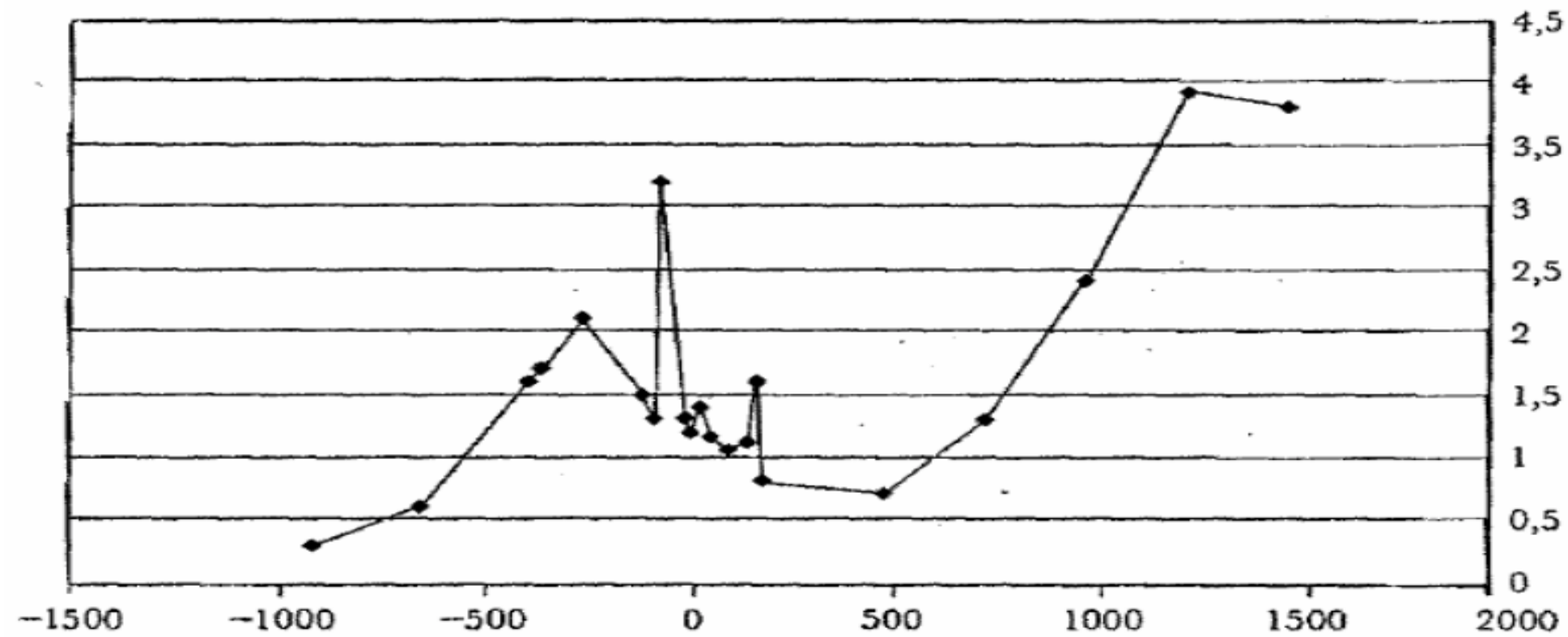
- No injustice or wickedness has ever attached to the glorious household of my kind lord, but it is ever full of mercy and overflowing to supply the needs of others.
- On account of this I, the wretched slave of my good lord, wish to bring it to your lordship's knowledge by this present entreaty for mercy that I serve my kind lord as my fathers and forefathers did before me and pay the taxes every year. And by the will of God... my cattle died, and I borrowed the not inconsiderable amount of 15 solidi....
- Yet when I approached my kind lord and asked for pity in my straits, those belonging to my lord refused to do my lord's bidding. For unless your pity extends to me, my lord, I cannot stay on my *ktema* and fulfill my services with regard to the properties of the estate.
- But I beseech and urge your lordship to command that mercy be shown to me because of the disaster that has overtaken me...



# 3.3.4. The Dark Age Begins...

**For the Roman Empire, the collapse of Roman authority was pronounced, particularly in the West:**

- By 450AD all the trappings of Roman economic prosperity were gone.
- Money vanished from circulation.
- Urban areas were abandoned and buildings stripped of stone.
- The roads were overgrown with weeds.
- The only type of pottery which was fabricated was crude and hand made, not manufactured.
- People forgot how to use mortar and they also forgot how to read and write.
- Roofs were made of branches, not tiles.
- The Eastern Roman Empire lived on, but it contracted significantly with the rise of Islam in the 7th Century.



Source: Jongman, Willem M. (2007) "Gibbon was Right: The Decline and Fall of the Roman Economy," in O. Hekster et. al. eds. *Crises and the Roman Empire*, Brill.



# Dell's Summary of Acemoglu & Robinson on the Fall of Rome

## **“Efflorescence” driven by good institutions:**

- Historically economic growth coincided with institutional innovation: creation of states with working political institutions that could provide public goods, law and order, encourage trade etc.
- Functioning states could also raise taxes and fund armies, allowing widespread conquests.
- However, they argue these were fundamentally extractive institutions, even if in some cases economic institutions were initially relatively inclusive.
- They argue that extractive growth is not sustained because there is little technological change. Moreover, it naturally creates political instability which eventually destroys the institutions which started the growth.



# The Late-Antiquity Pause

## Imperial Decline & Dark Age:

- **Axial Agrarian:**  
-1000 to 150:  
 $h=0.061\%/year$ ,  $g=0$ ,  $n=0.122\%/year$ ,  $P=50-200$
- **Late-Antiquity:**  
150:  
 $h=0.014\%/year$ ,  $g=0$ ,  $n=0.028\%/year$ ,  $P=200-240$
- **Mediæval Restoration:**  
150:  
 $h=0.051\%/year$ ,  $g=0$ ,  $n=0.102\%/year$ ,  $P=240-500$
- Why no further post-Axial growth acceleration?
- Why the Late-Antiquity Pause—& Dark Age?

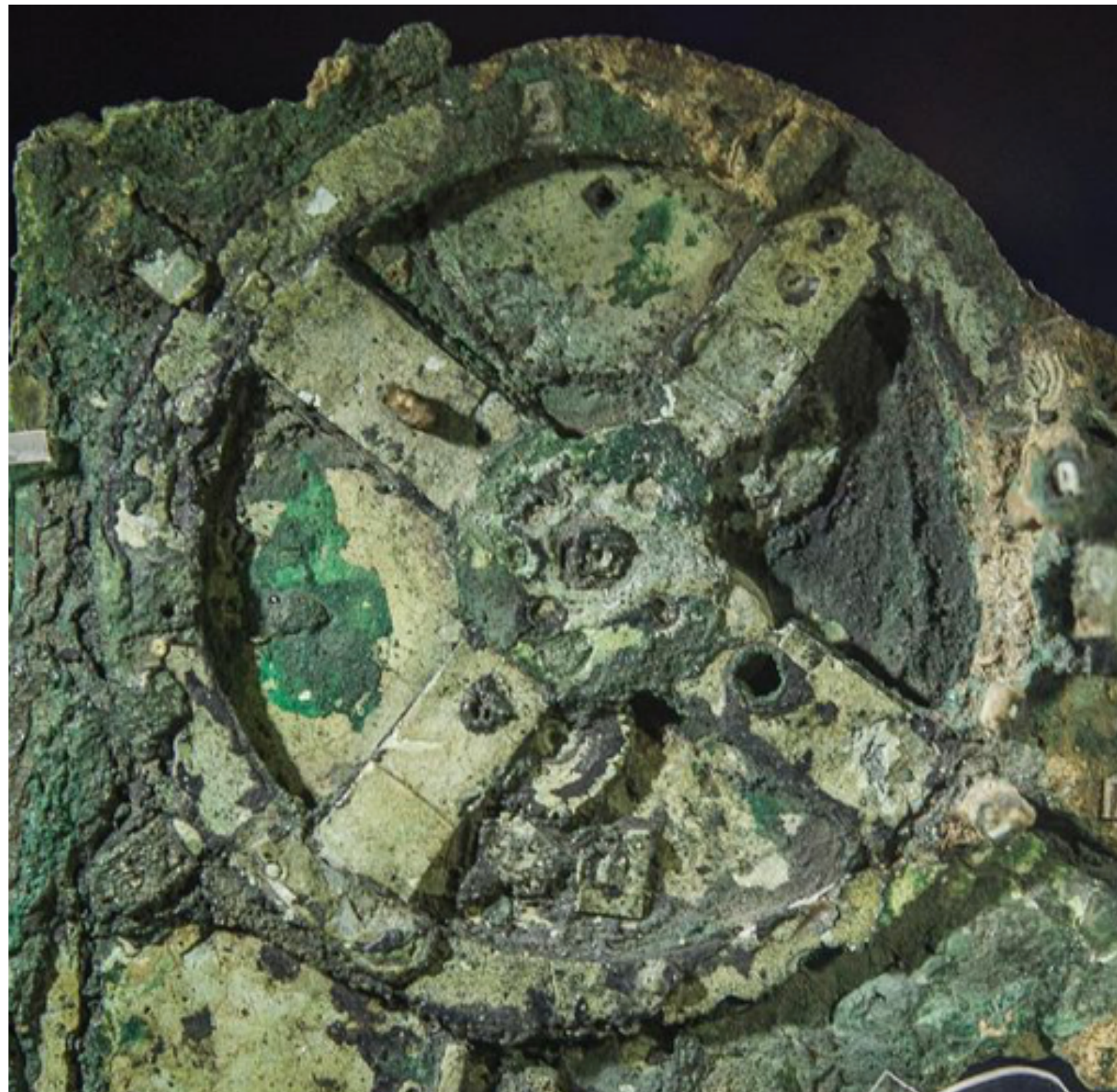




# The Anti-Kythera Mechanism

## What is this?

- Built between -150 and -70. Rhodes 13" x 7" x 4" wooden box. Gears—largest 5" in diameter
- Wikipedia: “37 gear wheels enabling it to follow the movements of the Moon and the Sun thru the zodiac, to predict eclipses and even to model the irregular orbit of the Moon, where the Moon's velocity is higher in its perigee than in its apogee. This motion was studied in the 2nd century BC by astronomer Hipparchus of Rhodes, and it is speculated that he may have been consulted in the machine's construction. The knowledge of this technology was lost at some point in antiquity. Similar technological works later appeared in the medieval Byzantine and Islamic worlds, but works with similar complexity did not appear again until the development of mechanical astronomical clocks in Europe in the fourteenth century...”



## What is this?

- Brian Resnick: “A main gear would move to represent the calendar year, and would, in turn, move many separate smaller gears to represent the motions of the planets, sun, and moon. So you could set the main gear to the calendar date and get approximations for where those celestial objects would be in the sky on that date.... You, as a user, could input a few simple variables and it would yield a flurry of complicated mathematical calculations.... All the user had to do was enter the main date on one gear, and through a series of subsequent gear turns, the mechanism could calculate things like the angle of the sun crossing the sky. (For some reference, mechanical calculators—which used gear ratios to add and subtract—didn’t arrive in Europe until the 1600s)...”



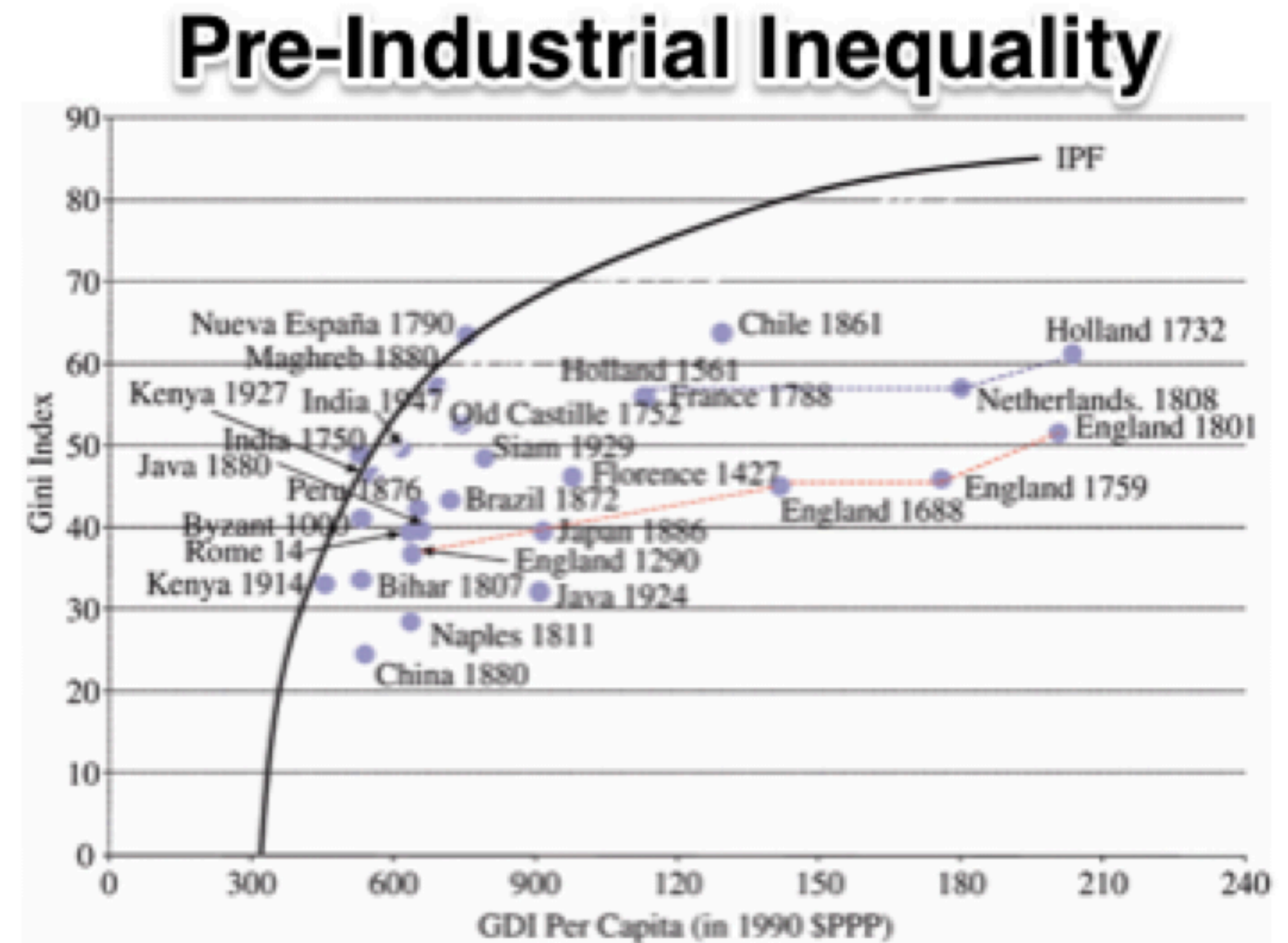
# “What Is Best in Life?”





# Domination & Plutocracy

- Ever since the invention of agriculture
- Becoming a trained-thug-with-a-spear
- The exploitative are hard targets
- The productive are soft targets
- Agrarian-Age as unequal as it could be
- No Commercial-Age reduction in inequality
- On the other hand, no big increase
- And domination mattered less—perhaps



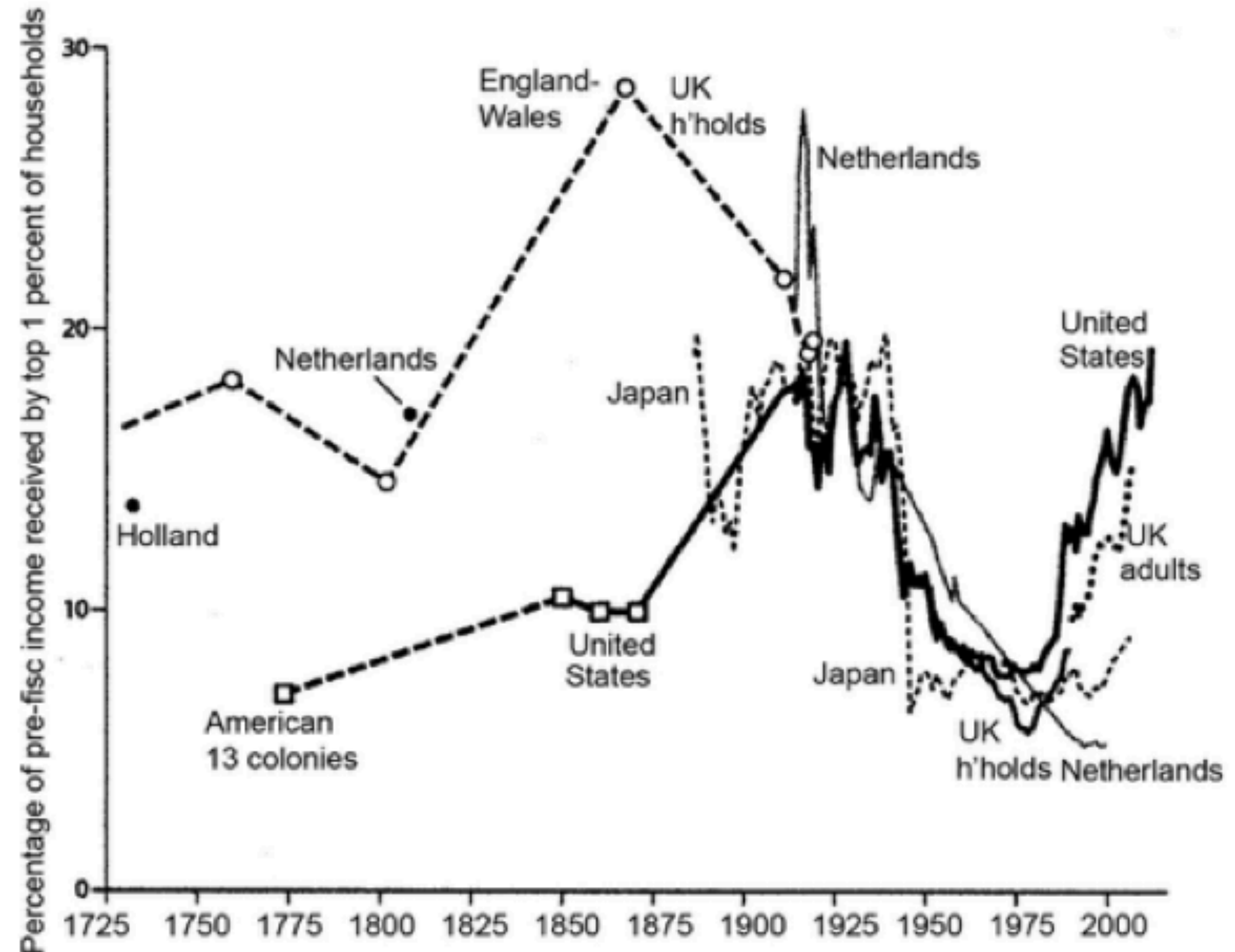
Branko Milanovic, Peter Lindert, and Jeffrey Williamson (2010): Pre-Industrial Inequality <<http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0297.2010.02403.x/full>>



# Commercial-Industrial-Modern Economic Growth Inequality

- “Top 1%” not static...
- Waves:
  - First Gilded Age
  - Age of Social Democracy
  - Second Gilded Age
- American numbers wrong

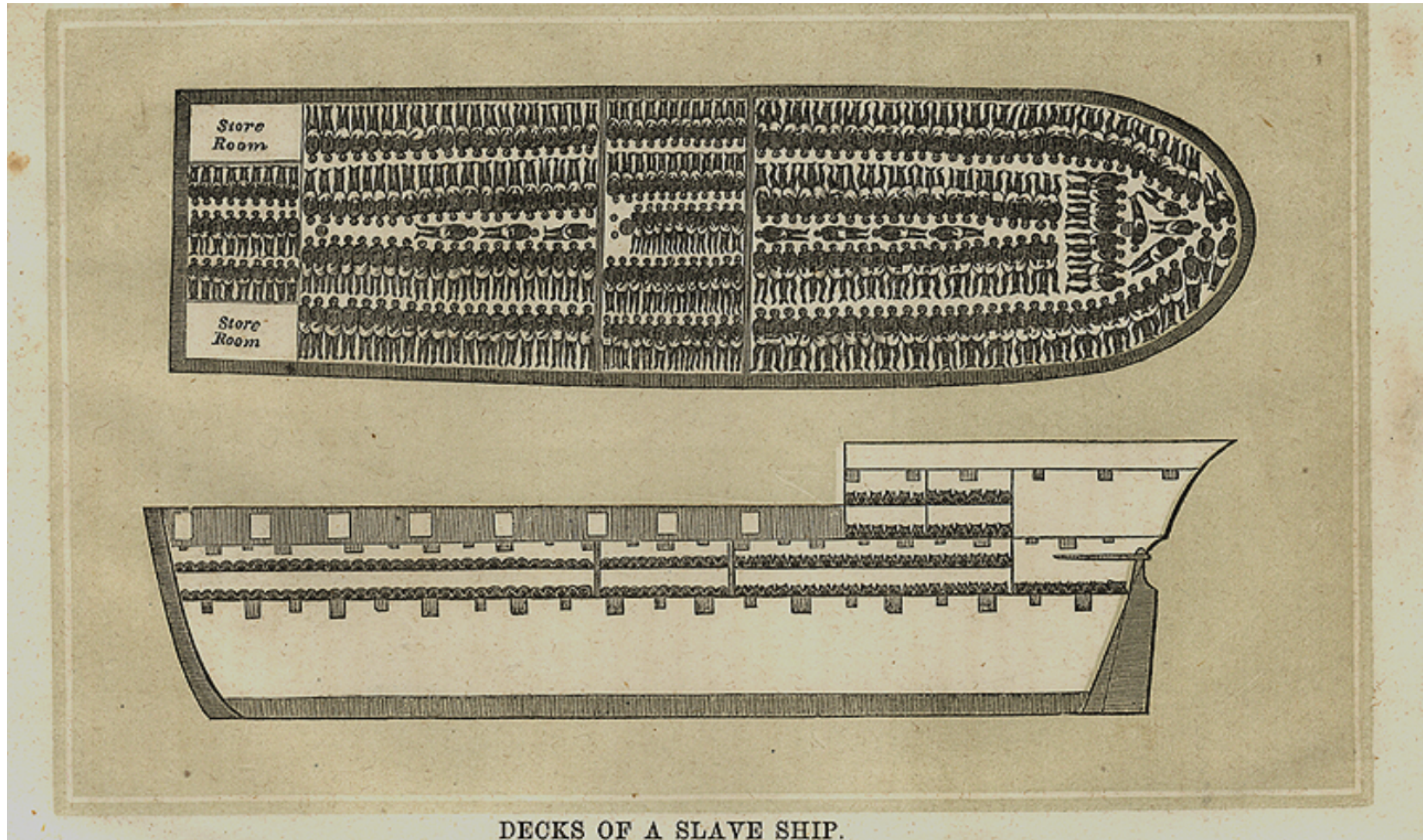
Figure 3 Income share received by the top 1%, four countries over two centuries





# Slavery & Status

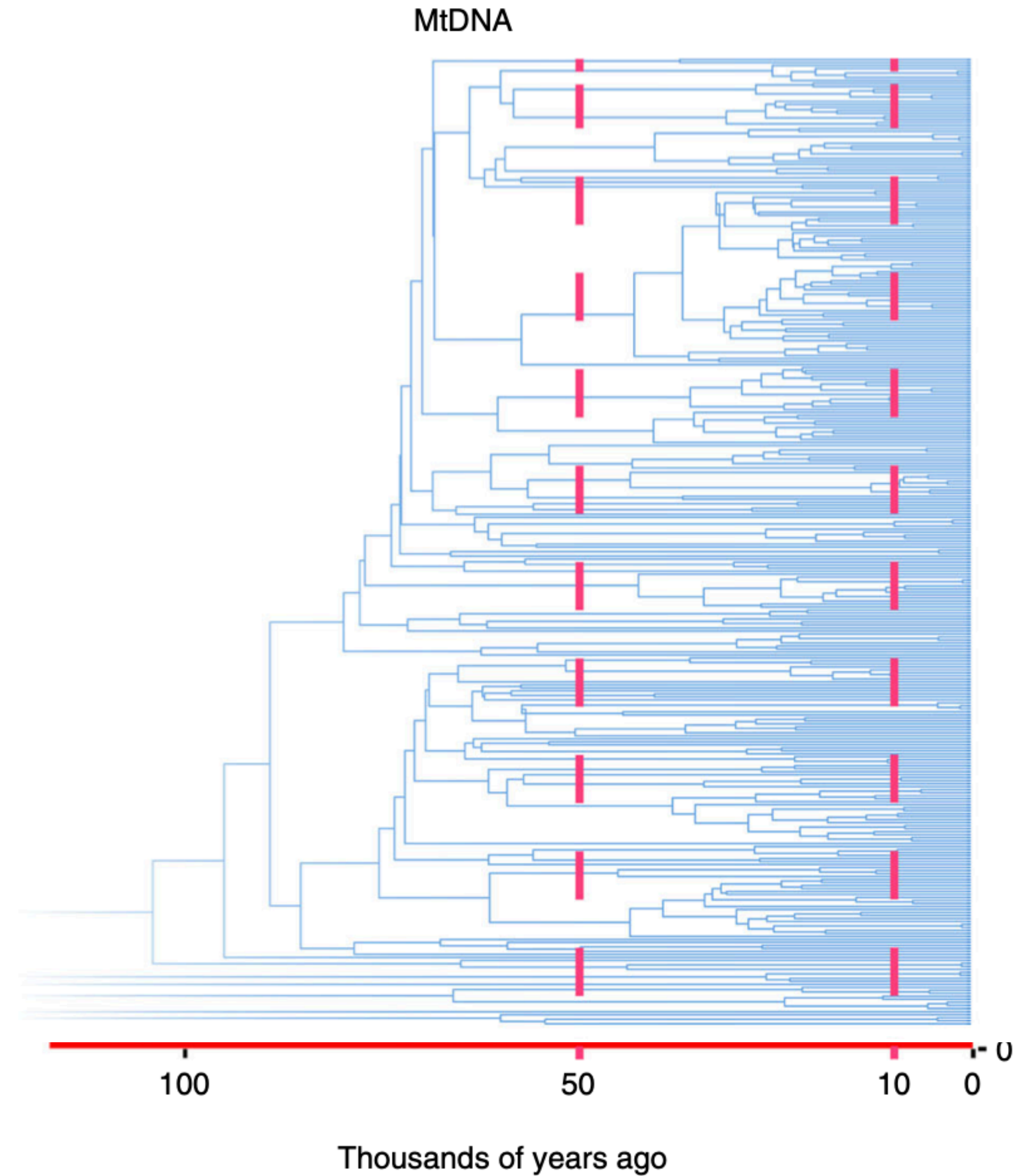
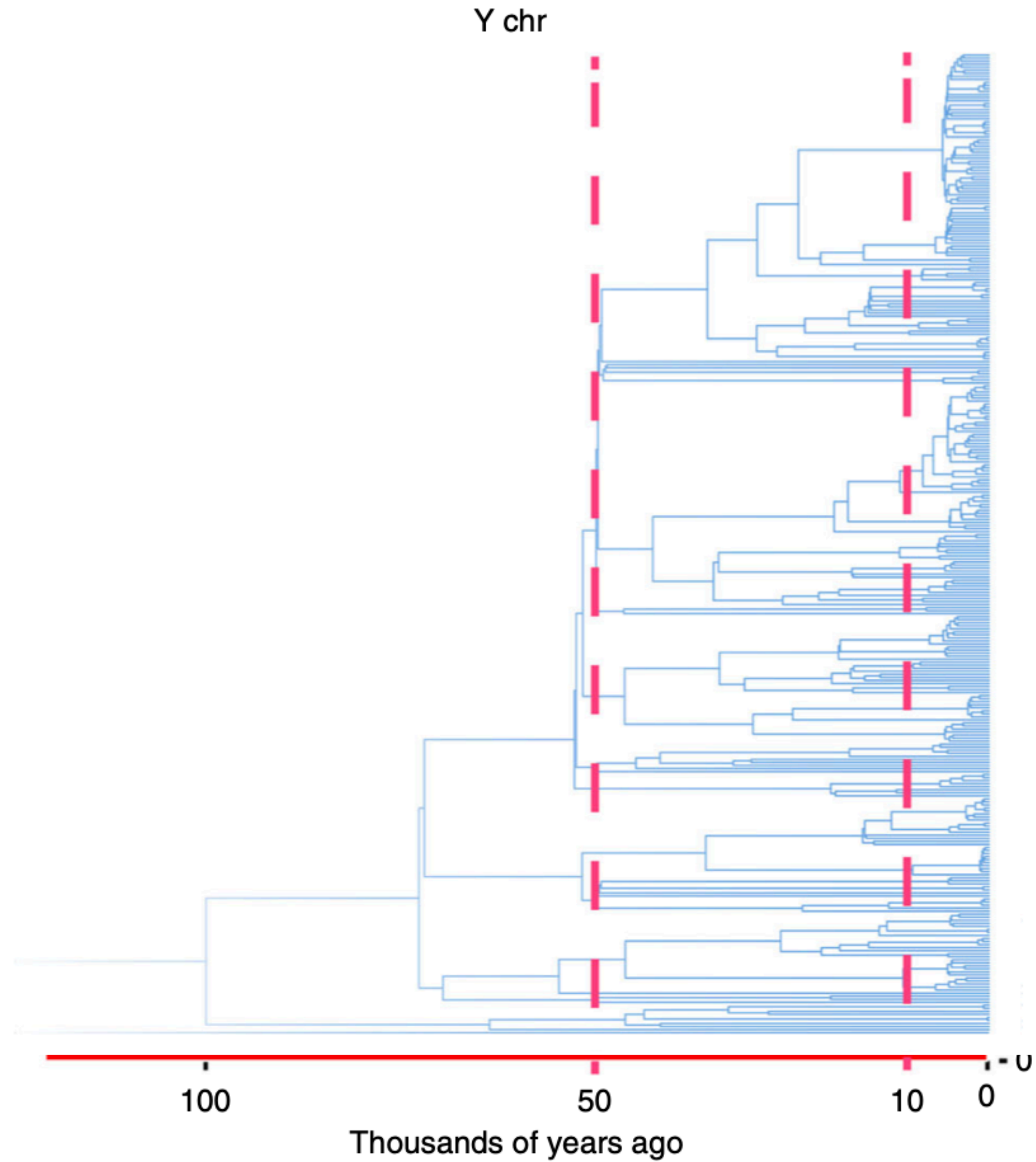
- Plantation
- Household
- Serfdom
- Sharecropping
- Debt
- Wage-work
- Renter
- Freehold



DECKS OF A SLAVE SHIP.

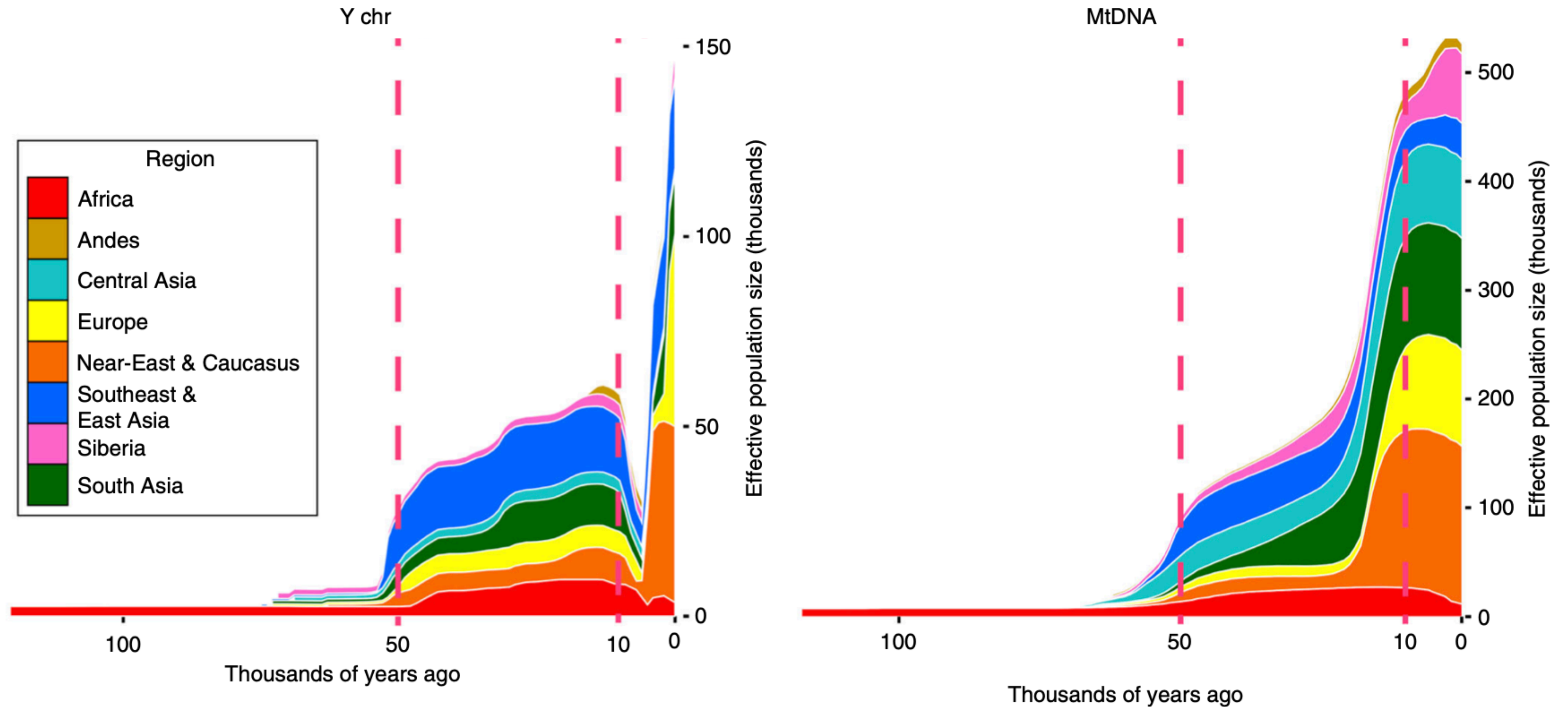


# Patriarchy: Genetic Divergence





# Patriarchy: Effective Population Size



**Fig. 1** Cumulative Bayesian skyline plots of Y-chromosome and mtDNA diversity by world regions. Reprinted from Karmin et al.<sup>4</sup> with permission from Monika Karmin and under a Creative Commons License (Attribution-NonCommercial 4.0 International)



# The Song of Everlasting Sorrow

姊妹弟兄皆列土，  
可憐光彩生門戶。

All her sisters and brothers had royal demesnes granted.  
Imperial but pitiful glory on the Yang family was bestowed.

遂令天下父母心，  
不重生男重生女。

On the mindset of all parents her success was a strong influence.  
Baby girls instead of baby boys became the popular preference.

- Tang Dynasty: An-Shi Rebellion
- Bai Juyi
  - Yang Guifei, Emperor Xuanzong, An Lushan, and Yang Guozhong
- The love of the Emperor was so strong as to upset the natural order, and so:
  - Baby girls instead of boys became the popular preference...
  - “In heaven we vow to fly wing to wing.  
On earth we vow to tangle branch to branch  
Heaven will fade, earth will fade  
Our parting is everlasting sorrow.”



Lady Yang Guifei



# Document: Abigail Smith Adams: Letter to John Adams

<https://tinyurl.com/dl20180226a>: Letter to John Adams 31 Mar-5 Apr 1776...

- Braintree March 31, 1776: I wish you would ever write me a Letter half as long as I write you; and tell me if you may:
  - Where your Fleet are gone?
  - What sort of Defence Virginia can make against our common Enemy?
  - Whether it is so situated as to make an able Defence?
  - Are not the Gentry Lords and the common people vassals?
  - Are they not like the uncivilized Natives Brittain represents us to be?
- I hope their Riffel Men who have shewen themselves very savage and even Blood thirsty; are not a specimen of the Generality of the people.





# Catch Our Breath

Let's reflect on what we have just heard & seen...

1. Comments
2. Questions
3. Readings

