Readings for the Next Lectures

Readings for the next lectures:

- Bocquet-Appel, Jean-Pierre (2011), "When the World's Population Took Off", *Science*

On Friday, we will talk about the referee report details.

Contributions to Growth

- So it seems that much of modern growth is the result of g_A
- But we need to be careful about how we interpret g_A
- We've called A technology but what exactly is it?
- Technically, its picking up everything that is not captured by K, L or Z
- This could include human capital, diminishing land quality, etc.
- So we need to be careful, A isn't just how good our computers are or the other ways we typically think about technology

Contributions to Growth

One quote from Abramovitz to keep in mind:

> *"This result is surprising in the lopsided importance which it appears to give to productivity increase, and it should be, in a sense, sobering, if not discouraging, to students of economic growth..."*

Contributions to Growth

One quote from Abramovitz to keep in mind (continued):

> *"Since we know little about the causes of productivity increase, the indicated importance of this element may be taken to be some sort of measure of our ignorance about the causes of economic growth..."*

How does this relate to the first several thousand years?

- So what does growth accounting tell us about the pre-industrial world?
- Generally, it tells us what to look at: technological change, capital per worker, land per worker
- It tells us that modern growth is largely about technological change
- It also shows that population growth tends to hold back income growth
- In our look at the pre-industrial world, we'll try to identify why we didn't achieve sustained growth
- This will (hopefully) tell us what had to change to enter the modern world

Technological Change and the Pre-Industrial World

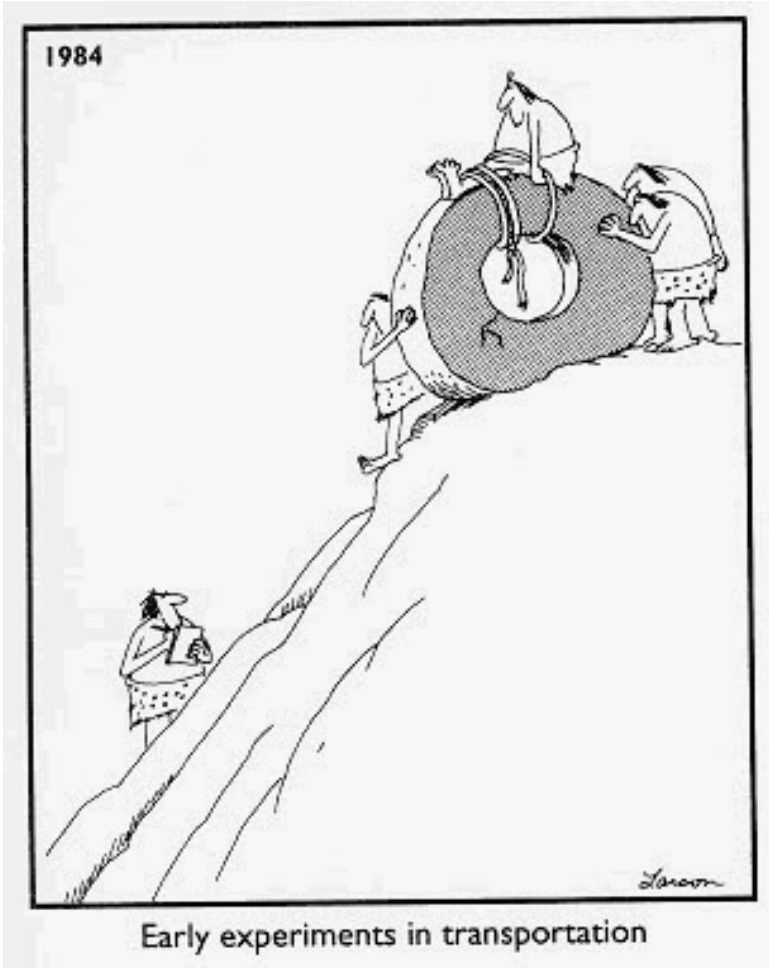
- A quick answer to stagnant standards of living in the pre-industrial world is that we simply didn't have technological change
- The quick response to this quick answer is, "That's ridiculous."
- There were incredible changes in technology before the industrial revolution.
- Think of what the world was capable of in 3000 B.C. versus what it was capable of in 1600 A.D.

The Pre-Industrial World's Greatest Hits

Prometheus Carrying Fire, Jan Cossiers, 17th century

The Pre-Industrial World's Greatest Hits

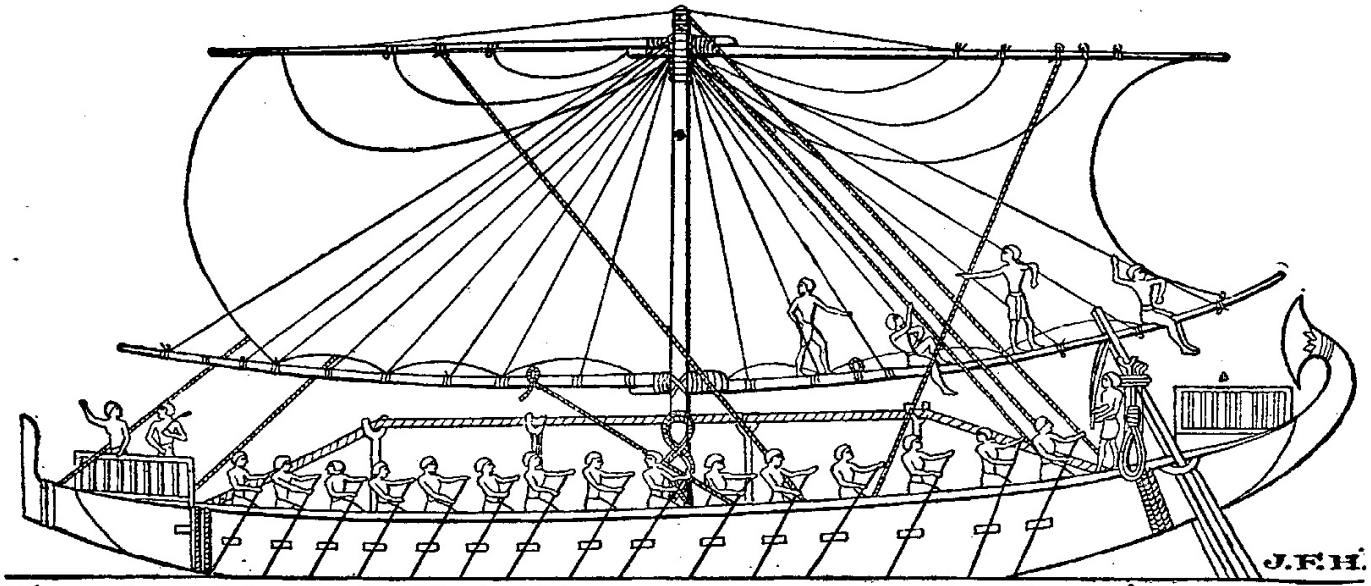
The Pre-Industrial World's Greatest Hits



Gary Larson, The Far Side

The Pre-Industrial World's Greatest Hits

The Pre-Industrial World's Greatest Hits

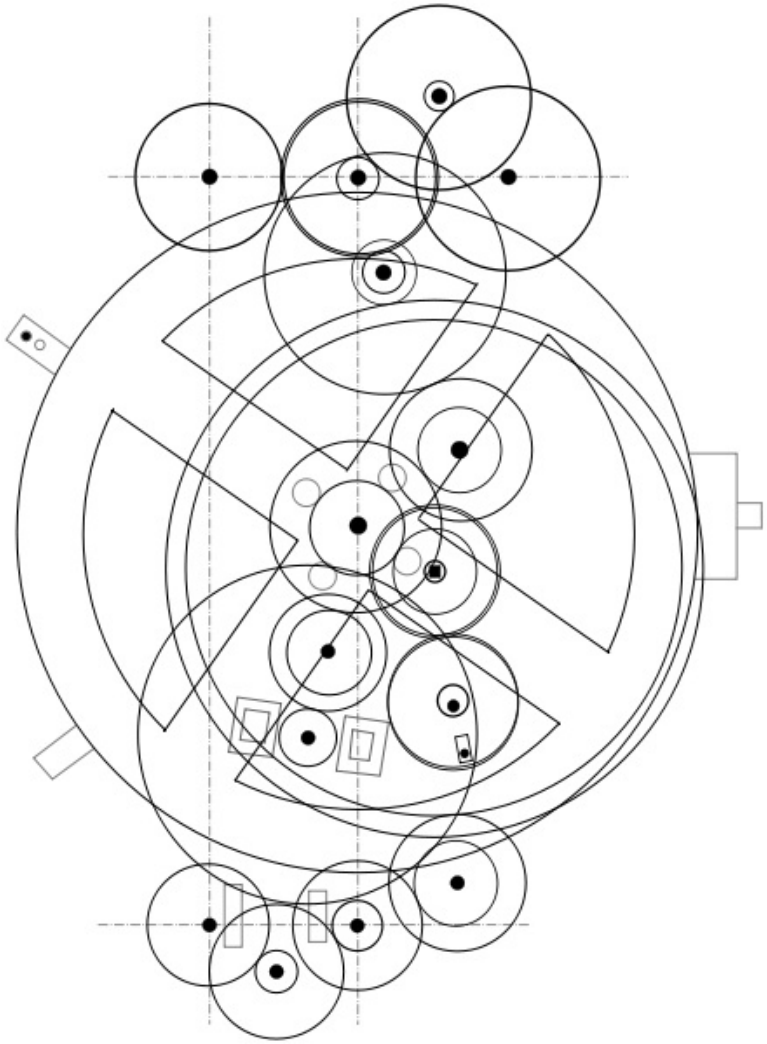


Egyptian ship on the Red Sea, about 1250 B.C. [From Torr's "Ancient Ships."]
Mr. Langton Cole calls attention to the rope *truss* in this illustration, stiffening the beam of the ship. No other such use of the truss is known until the days of Modern engineering.

The Pre-Industrial World's Greatest Hits

Antikythera mechanism fragment

The Pre-Industrial World's Greatest Hits



Antikythera mechanism schematic

The Pre-Industrial World's Greatest Hits

Technological Change and the Pre-Industrial World

- The pre-industrial world is full of big, big innovations
- The structure and capacity of the economy was transformed multiple times in dramatic ways
- Yet these changes didn't have lasting effects on the standard of living
- We'll explore three specific moments in history to try to understand this:
  - The neolithic revolution
  - The black death
  - European shipping empires

Explaining Pre-Industrial Stagnation

- Before we get to the actual test cases, we're going to build a conceptual framework to make some predictions
- What we need is a model that ties together standard of living and technology
- Standard of living is going to depend on not only how much we produce, but how many people we divide it between (note Kenya on the tables in the previous lecture)
- So our model also needs to take into account population change
- What does population change look like?

Population in the Modern World

First, a few definitions:

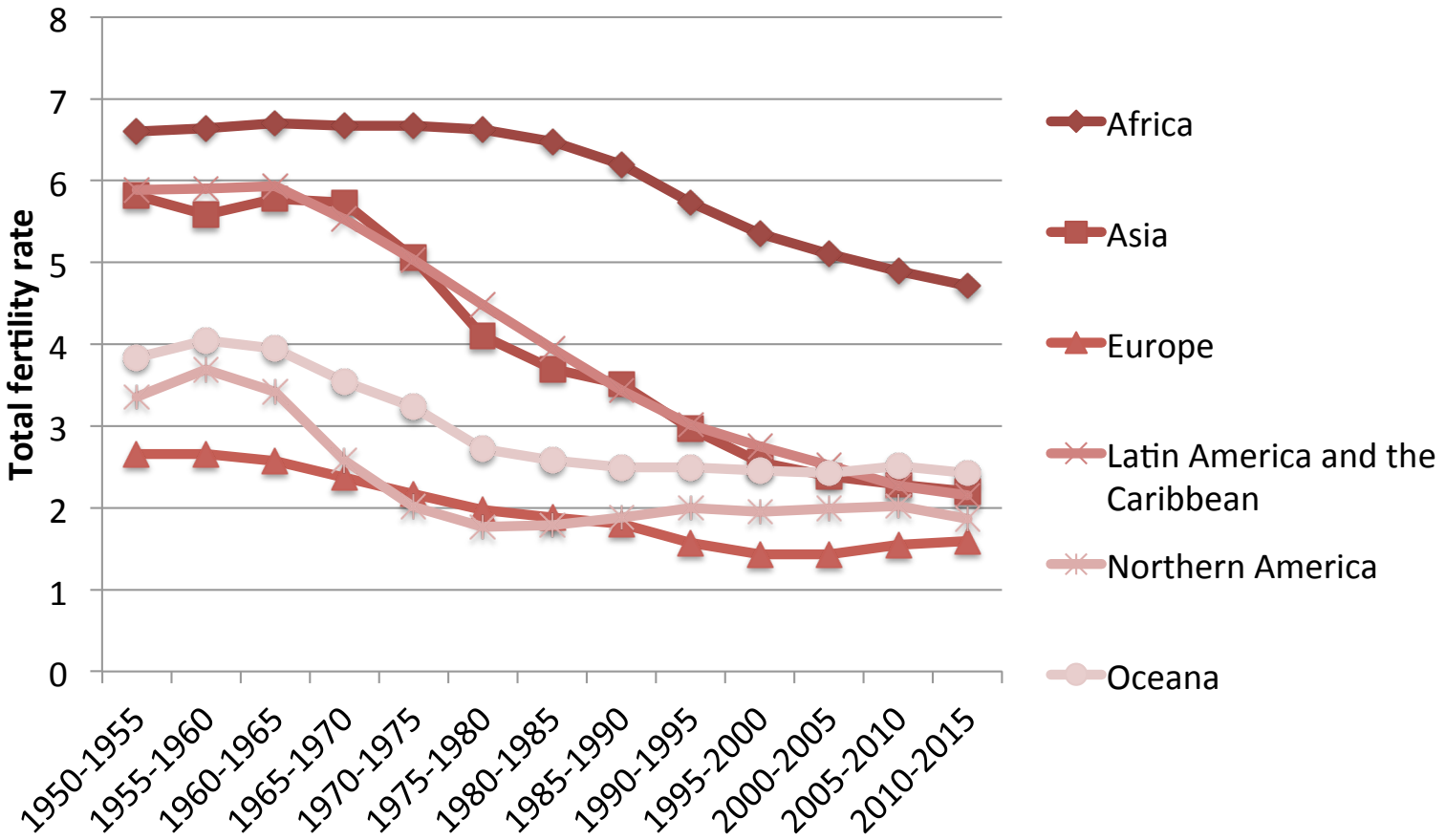
- **Crude birth rate**: annual number of births per thousand population
- **Total fertility rate**: average number of children born to a woman over her lifetime if (1) she experienced current age-specific fertility rates and (2) she survived from birth to the end of her reproductive career
- **Replacement fertility**: total fertility rate at which population levels are sustained (2.1 births per woman in developed countries, 2.5 to 3.3 birth per woman in developing countries, 2.33 globally)

Population in the Modern World

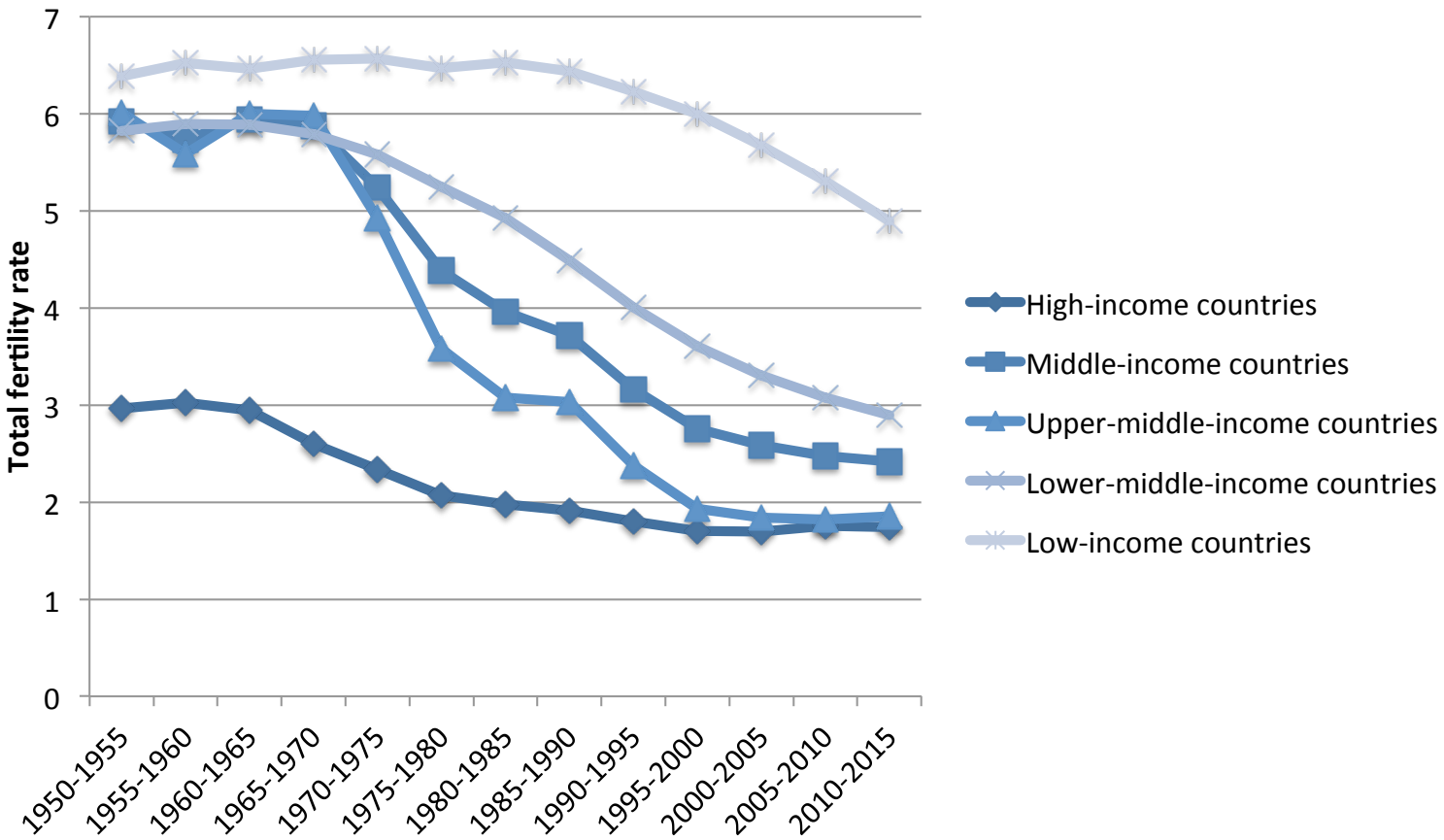
First, a few definitions (continued):

- **Gross reproduction rate**: average number of daughters born to a woman over her lifetime assuming if (1) she experienced current age-specific fertility rates and (2) she survived from birth to the end of her reproductive caree
- **Net reproduction rate**: average number of daughters born to a woman over her lifetimes assuming she experienced current age-specific fertility rates but accounting for mortality (a rate of 1 would mean no population growth)

Population in the Modern World



Population in the Modern World



Population in the Modern World

Population growth in the United States, 1850-2010

Year	Population (in thousands)	Surviving children per woman
1850	23,261	--
1870	39,905	--
1890	63,056	--
1910	92,407	2.672
1930	123,188	1.968
1950	151,684	2.870
1970	205,089	2.336
1990	250,181	1.994
2010	309,776	--

Population in the Preindustrial World

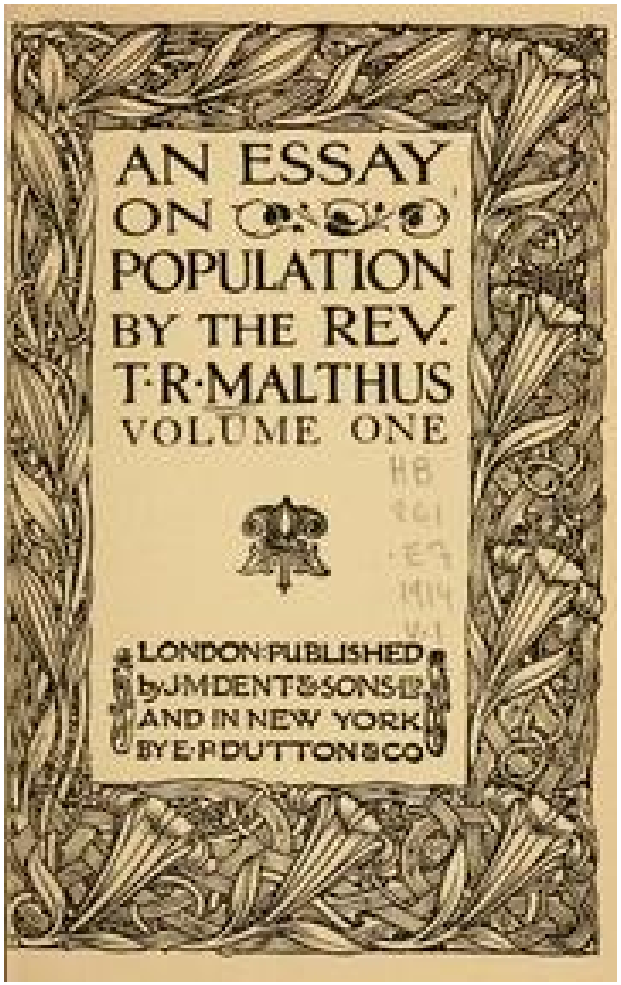
Location	Population in 1300	Population in 1800	Surviving children per woman
Norway	0.4	0.88	2.095
Southern Italy	4.75	7.9	2.061
France	17	27.2	2.056
England	5.8	8.7	2.049
Northern Italy	7.75	10.2	2.033
Iceland	0.084	0.047	1.93

Note: population is given in millions.

The Malthusian Trap

The Reverend Thomas Robert Malthus

The Malthusian Trap



Essay on the Principle of Population, 1798

The Malthusian Trap

A basic but powerful framework was proposed in the late 1700s by Thomas Robert Malthus, built upon two basic principles:

- *"First, That food is necessary to the existence of man."*
- *"Second, That the passion between the sexes is necessary and will remain nearly in its present state."*

The Malthusian Trap

These two basic principles lead to societies being trapped at a particular standard of living. According to Malthus:

> *Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio...This implies a strong and constantly operating check on population from the difficulty of subsistence.*

Explaining Stationary Populations

- One of the key differences between the preindustrial world and the modern world was that population size was pretty much static
- Malthus helps provide a very simple economic argument for why this was the case that we'll try to formalize
- 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

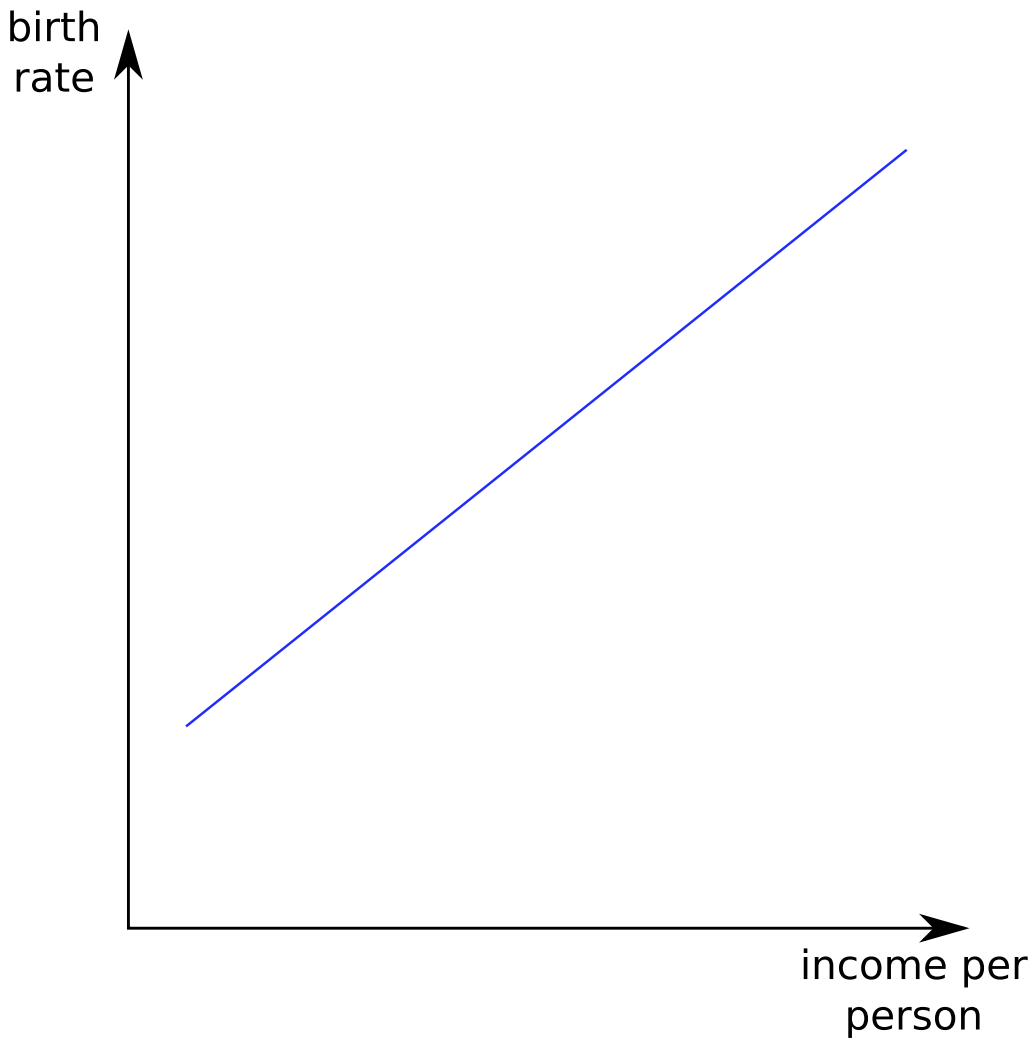
The Birth Rate Schedule

- 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



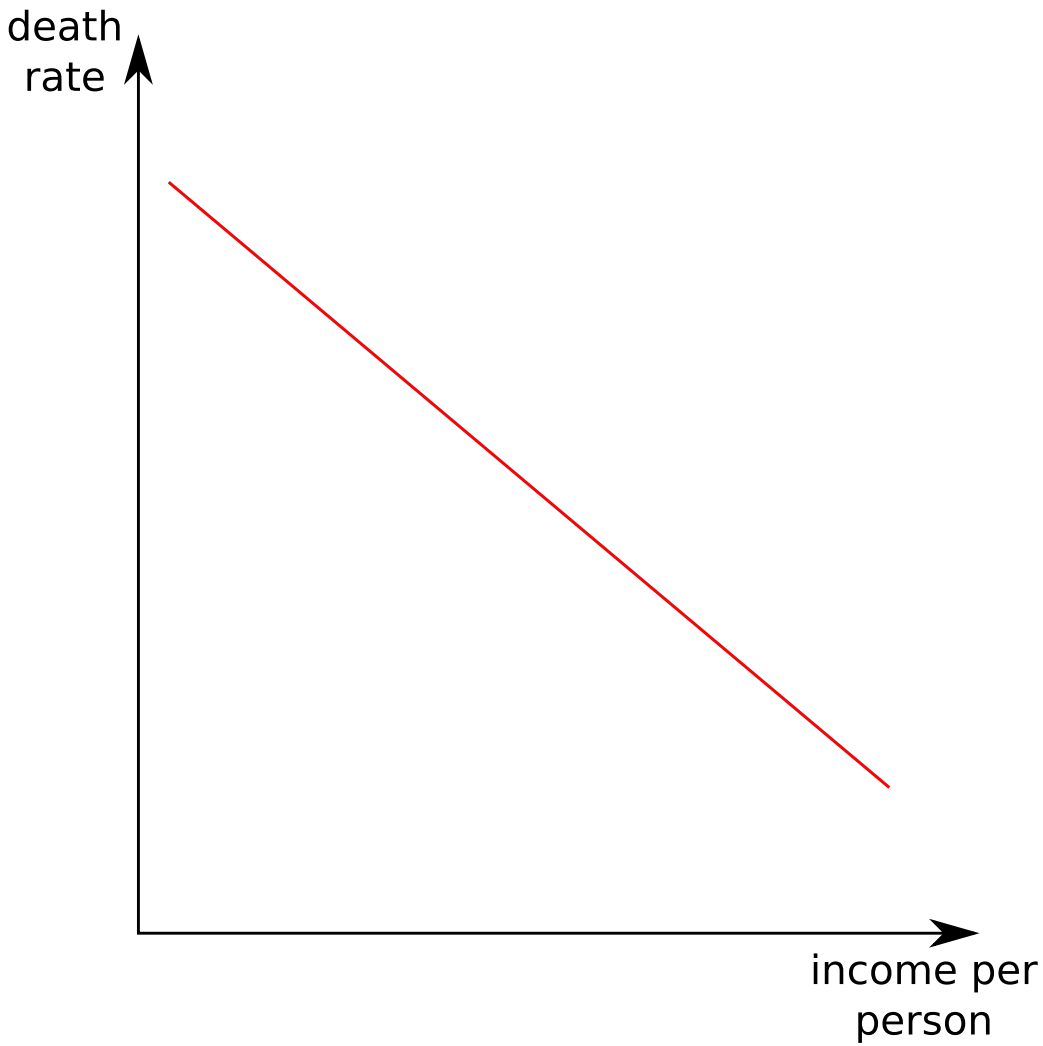
The Death Rate Schedule

- 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

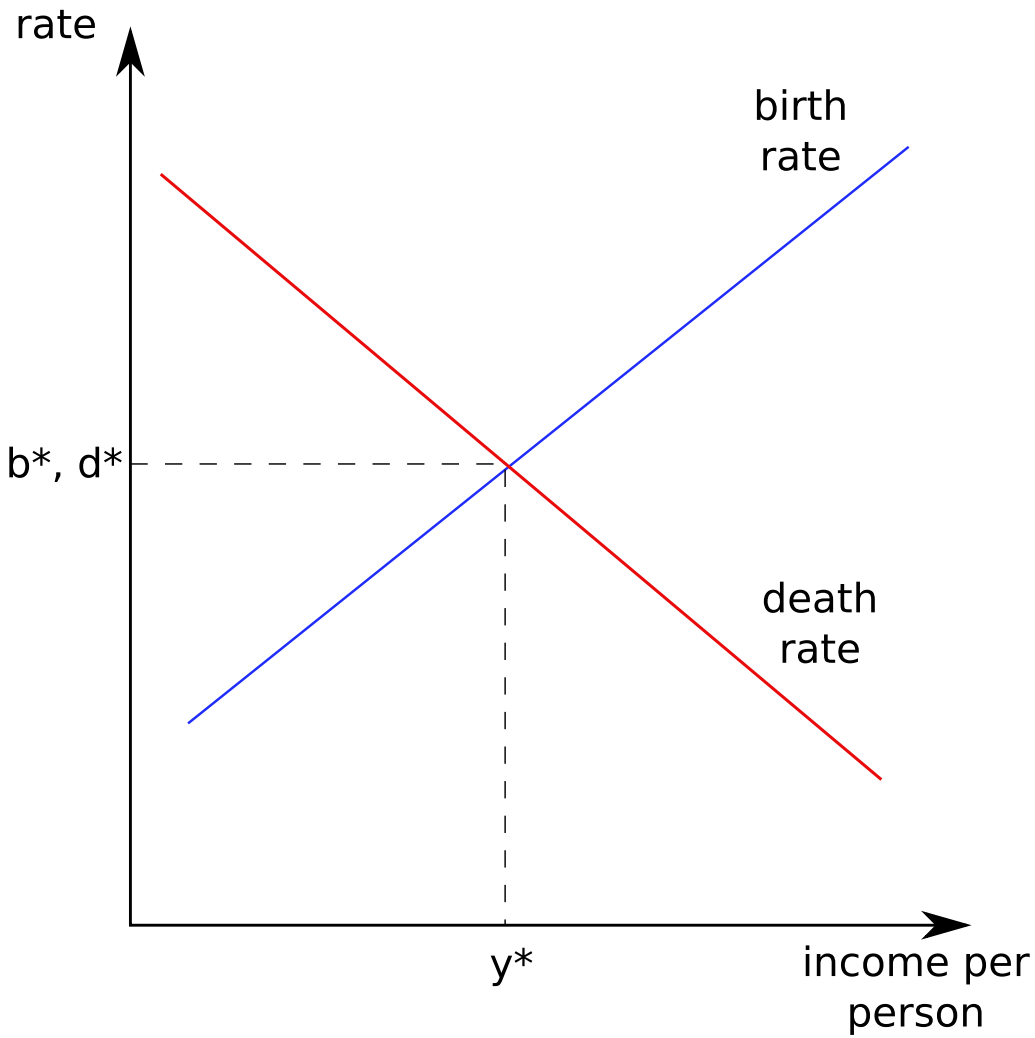
The Death Rate Schedule



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*)

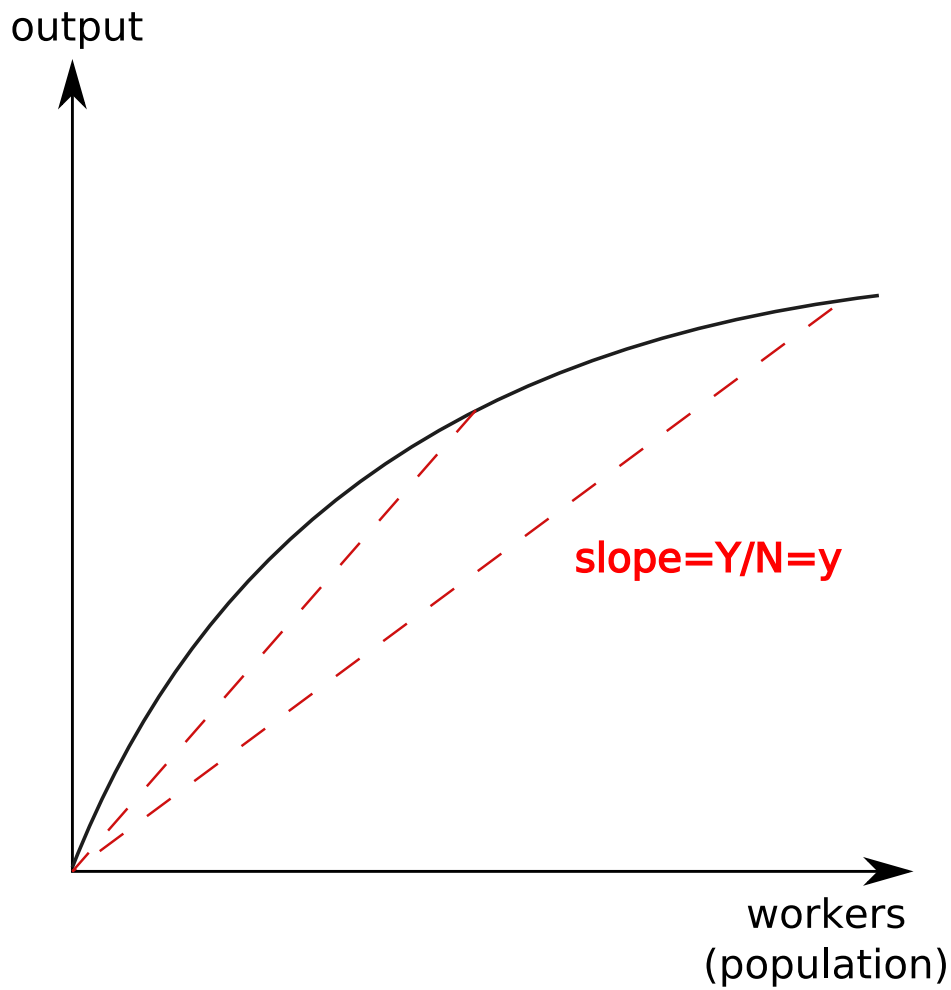
Stationary Population



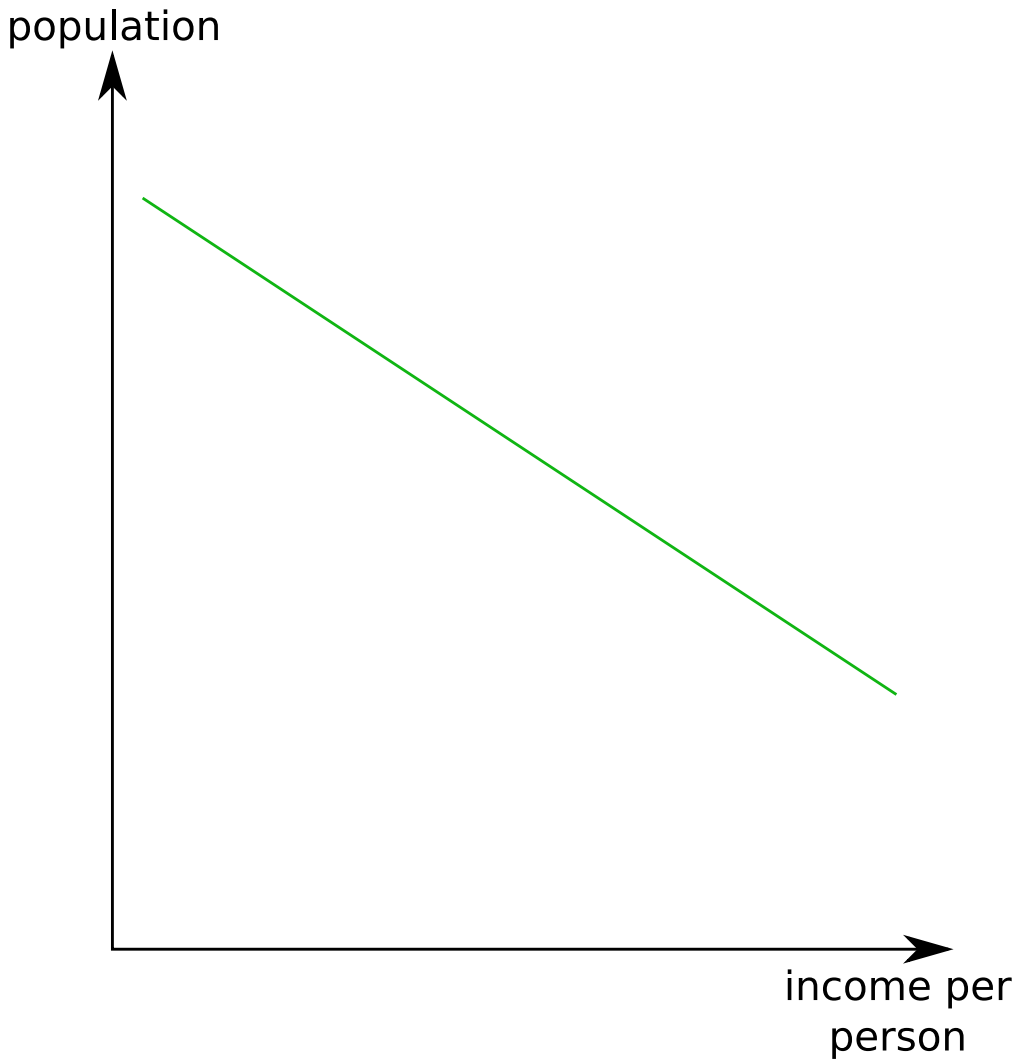
Stationary Population

- 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

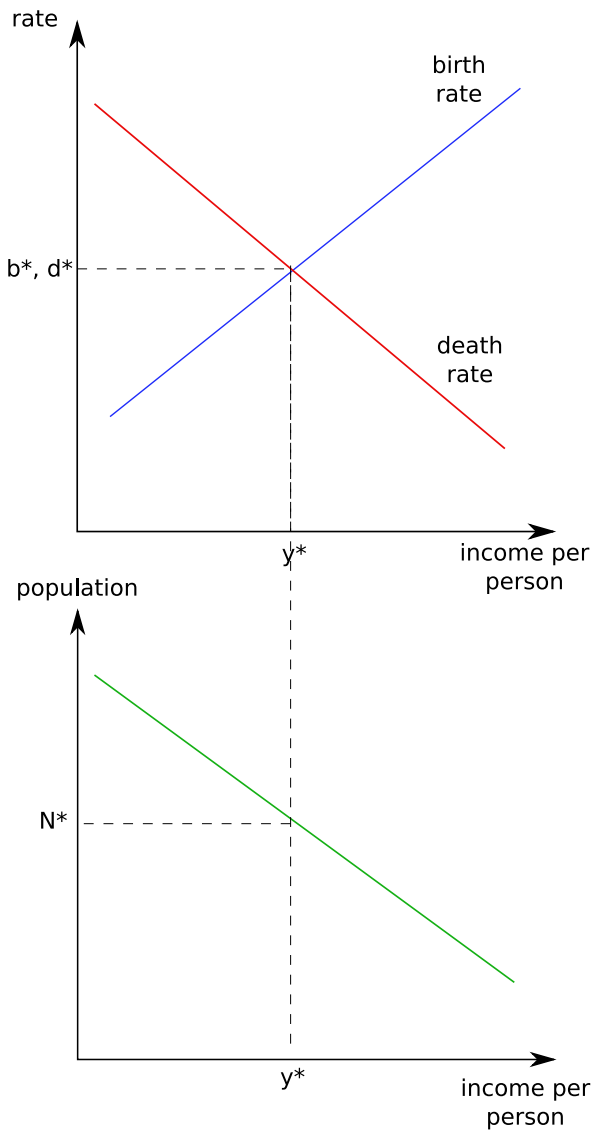
Diminishing Marginal Product of Workers



The Technology Curve



The Malthusian Equilibrium



Referee Report

- The first referee report is coming up, it is due February 16th at 5pm
- For the first part of today's lecture we're going to talk about what a referee report is
- We'll discuss how the publication process works in economics, how I write referee reports, and how you should write your referee report (which is not the same as how I write mine)
- The key details are contained in a handout posted on our Blackboard site (and handed out)

From Idea to Publication

Here is the basic timeline of an economics paper:

1. Come up with the idea, gather data, run regressions, gather more data, run more regressions . . .
2. Write up a working paper version of the paper
3. Present at conferences, workshops and seminars, do more analysis and rewrites based on feedback
4. Polish the paper
5. Send the paper to the best journal you think it has a chance out
6. Hopefully receive referee reports and a chance to revise, if not return to step 4
7. Do everything the referees ask for and send it back to the journal
8. Repeat steps 5 and 6 until acceptance or rejection
9. If rejected return to step 4

From Idea to Publication

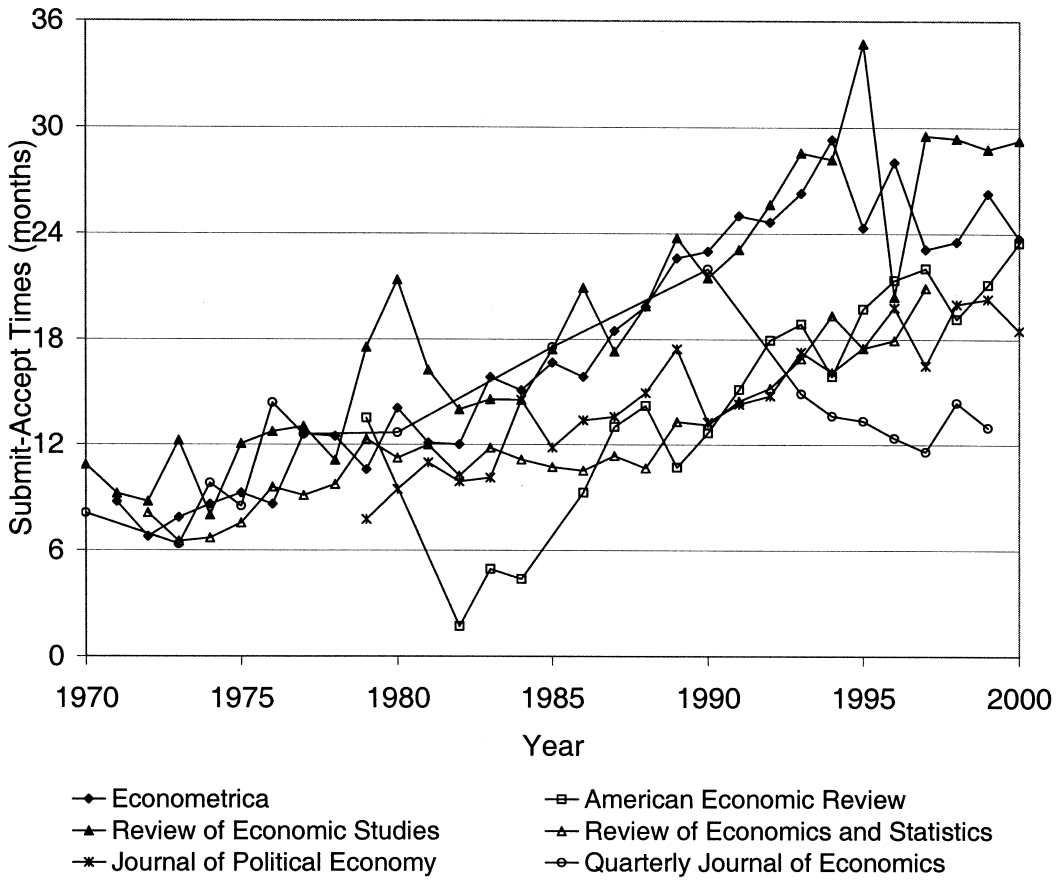


FIG. 1.—Mean submit-accept times for papers in top general-interest journals

From Idea to Publication

TABLE 1
MEAN SUBMIT-ACCEPT TIMES AT VARIOUS JOURNALS

JOURNAL	MEAN TOTAL REVIEW TIME IN YEAR			
	1970	1980	1990	1999
	Top Five General-Interest Journals			
AER		13.5*	12.7	21.1
Econometrica	8.8†	14.0†	22.9†	26.3†
JPE		9.5	13.3	20.3
QJE	8.1	12.7	22.0	13.0
REStud	10.9†	21.5	21.2	28.8
	Other General-Interest Journals			
Canadian J. Econ.		11.3*		16.6
Econ. Inquiry		3.4*		13.0
Econ. J.		9.5*		18.2†
Internat. Econ. Rev.	7.8†	11.9†	15.9†	16.8†
REStat	8.1	11.4	13.1	18.8
	Economics Field Journals			
J. Appl. Econometrics			16.3†	21.5†
J. Comparative Econ.		10.3†	10.9†	10.1†
J. Development Econ.	5.6†‡	6.4†	12.6†	17.3†
J. Econometrics		9.7†	17.6†	25.5†
J. Econ. Theory	.6†	6.1†	17.0†	16.4†
J. Environmental Econ. and Management		5.5†	6.6†	13.1†
J. Internat. Econ.		8.7*		16.2
J. Law and Econ.		6.6*		14.8
J. Math. Econ.	2.2†‡	7.5†	17.5	8.5
J. Monetary Econ.			11.7†	16.0†
J. Public Econ.	2.6†§	12.5†	14.2†	9.9†
J. Urban Econ.		5.4†	10.3†	8.8†
Rand J. Econ.		7.2*	20.0	20.9
	Journals in Related Fields			
Accounting Rev.		10.1	20.7	14.5
J. Accounting and Econ.		11.4†	12.5†	11.5†
J. Finance		6.5*		18.6
J. Financial Econ.	2.6†‡	7.5†	12.4†	14.8†

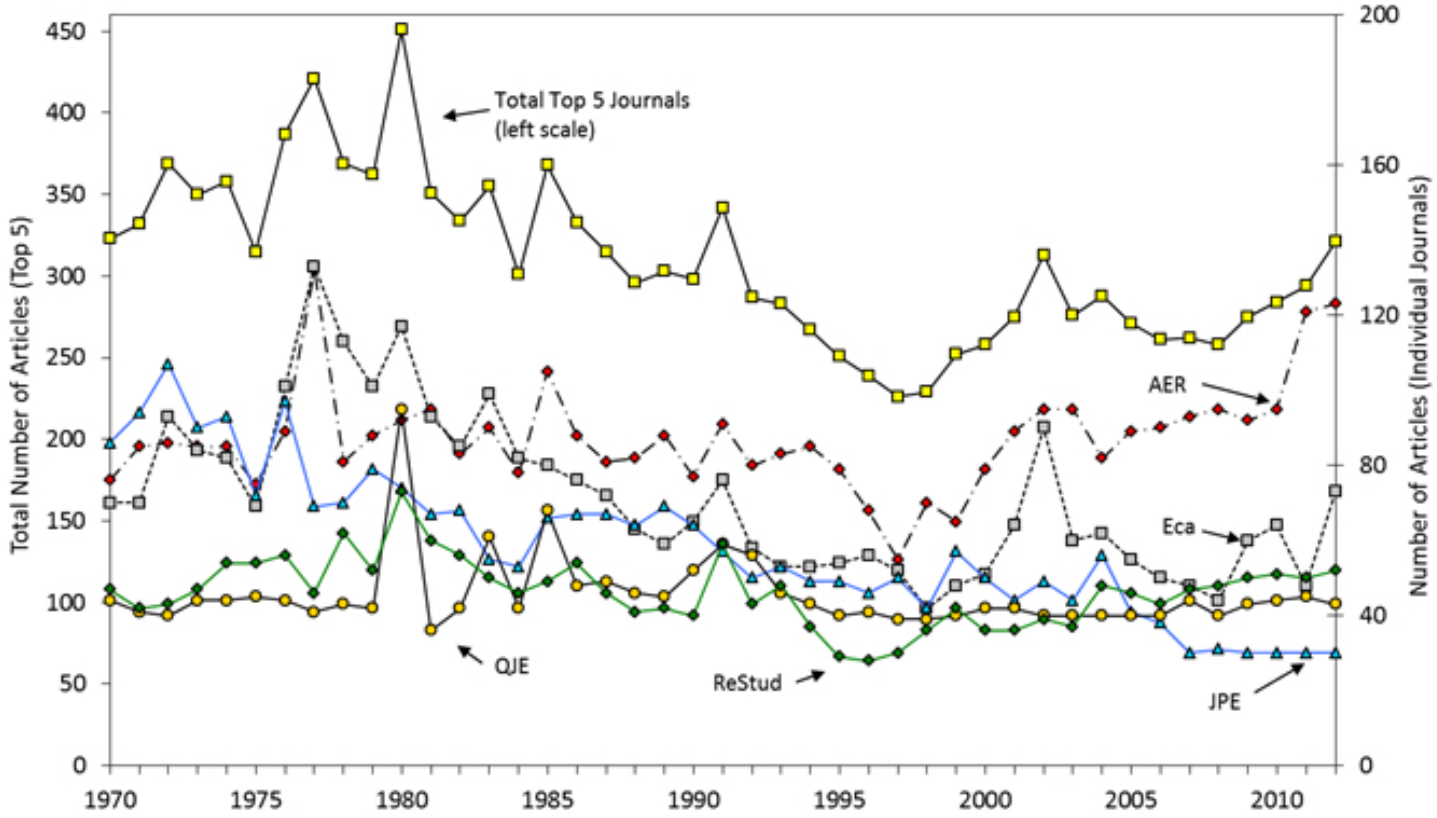
* Date from Yohe (1980) pertain to 1979 and probably do not include the review time for the final resubmission.
† Does not include review time for final resubmission.
‡ Data for 1974.
§ Data for 1972.

From Idea to Publication

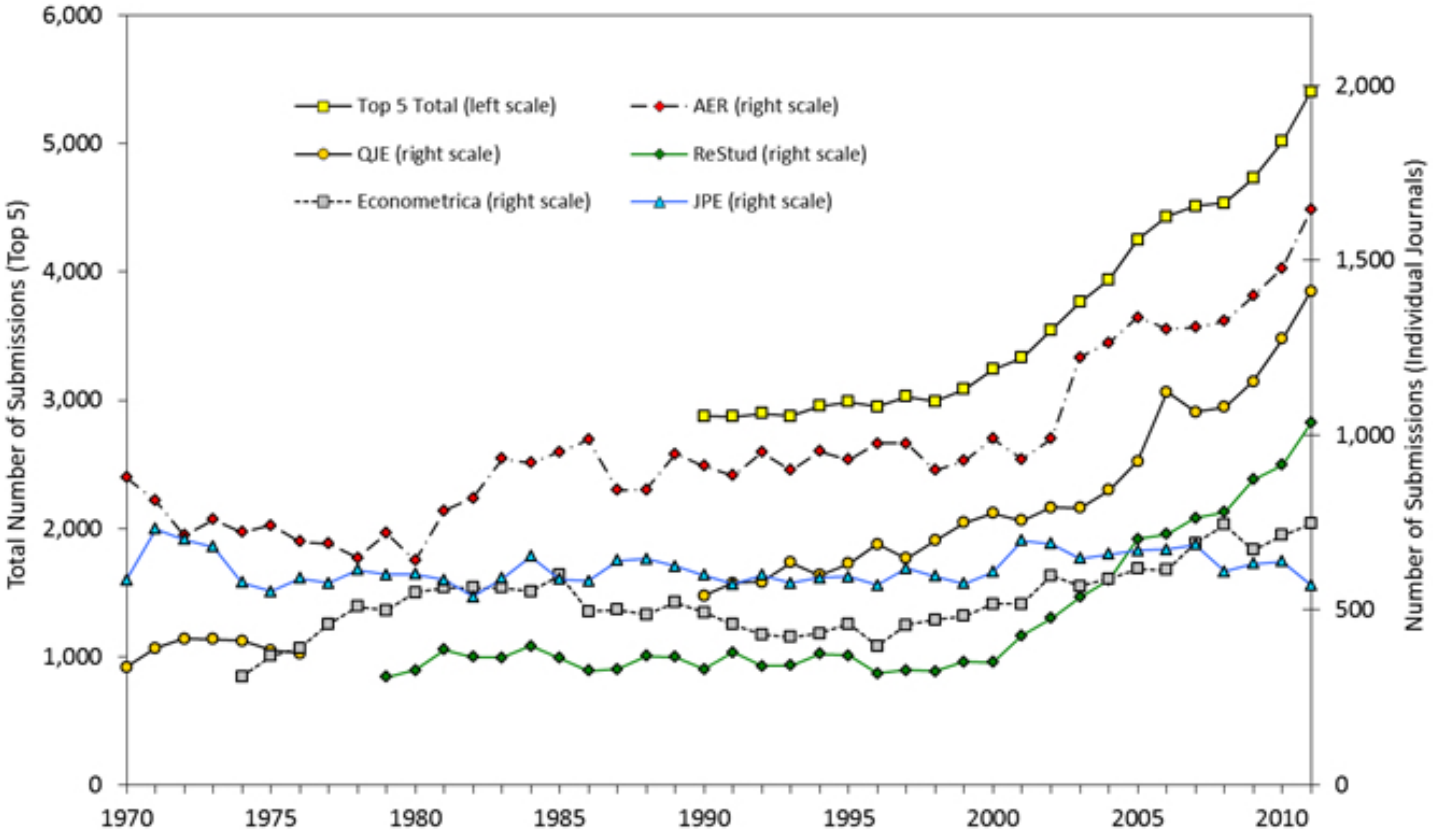
TABLE 3
REVISIONS AT THE *QJE*

	Year of Publication								
	1940	1950	1960	1970	1980	1985	1990	1995	1997
Mean submit-accept time (months)	3.7	3.8	3.6	8.1	12.7	17.6	22.0	13.4	11.6
Mean number of revisions	.6	.8	.6	1.2	1.4	1.5	1.7	2.2	2.0
Mean number of revisions before acceptance	.4	.1	.2	.5	.8	1.0	1.7	2.2	2.0
Mean author time for first preaccept revision (months)	1.4	2.1	2.0	2.1	3.0	4.2	3.6	4.1	4.7

From Idea to Publication



From Idea to Publication



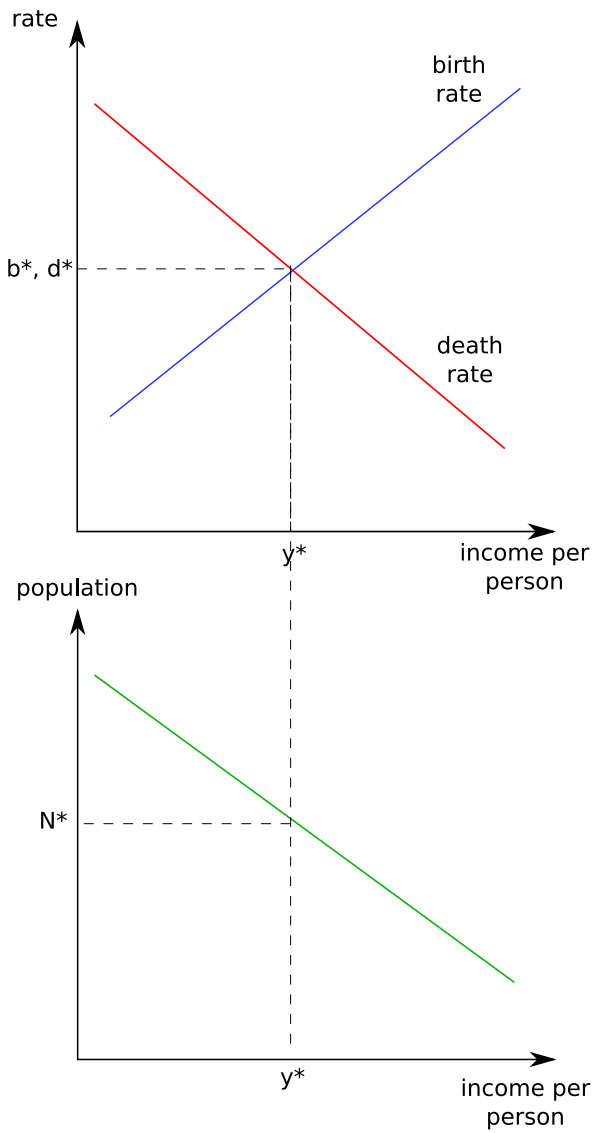
The Referee Process

- Peer review at economics journals is intended to accomplish two things:
  - Ensure the technical correctness of articles
  - Ensure that articles significantly add to our body of knowledge
- The referee assesses a paper both for correctness and for the novelty and size of its contribution
- The referee relays this assessment to the editor
- The referee also prepares a report for the authors, summarizing the paper and highlighting its strengths and weaknesses
- This report typically contains suggestions for improving the paper

The Referee Process

Now let's look at some sample referee reports and talk about what I expect in your reports.

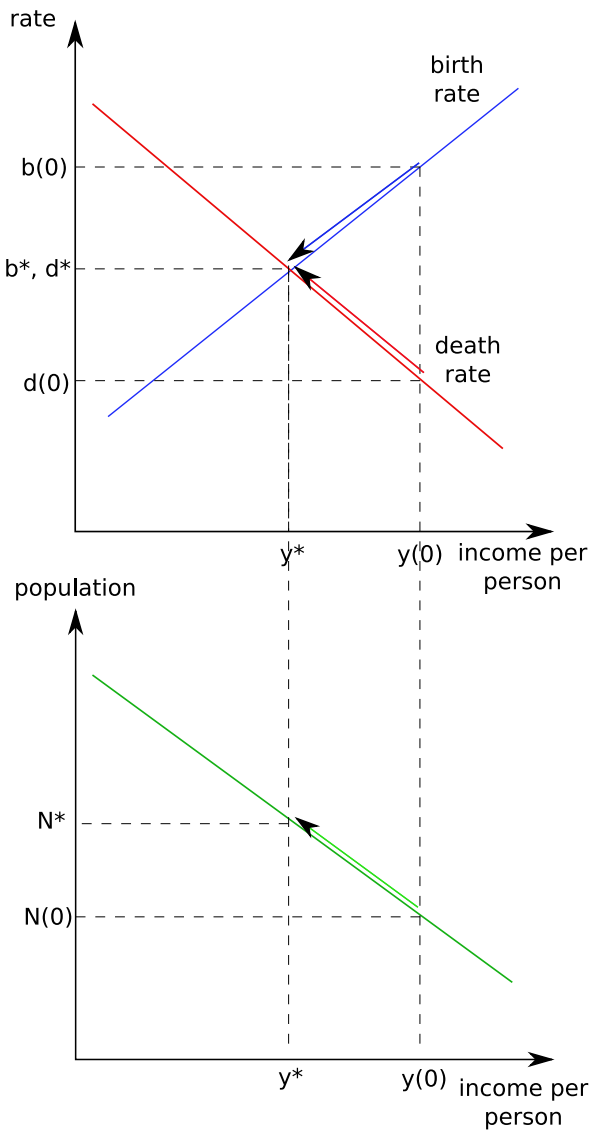
The Malthusian Equilibrium



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

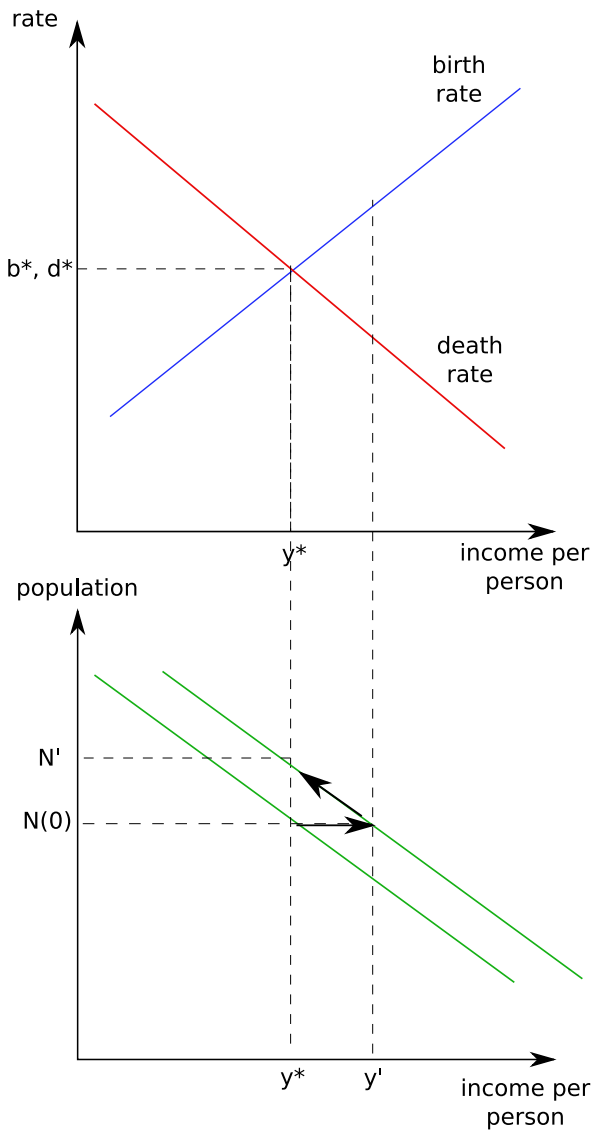
The Effects of a Change in Technology

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



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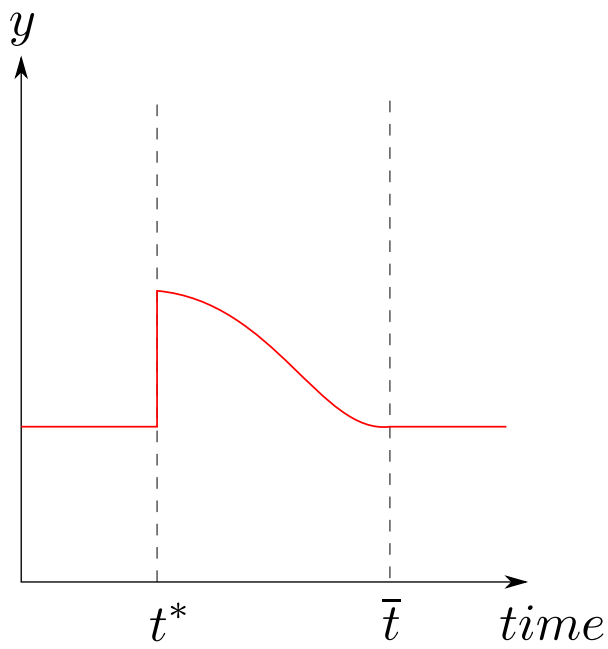
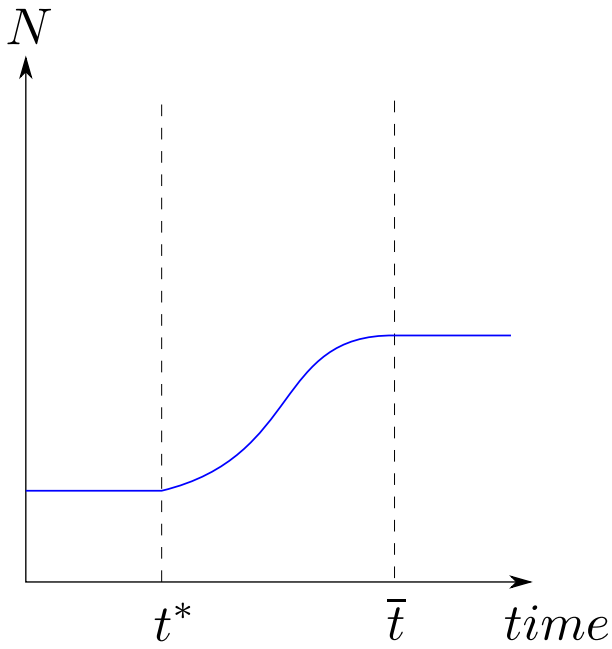


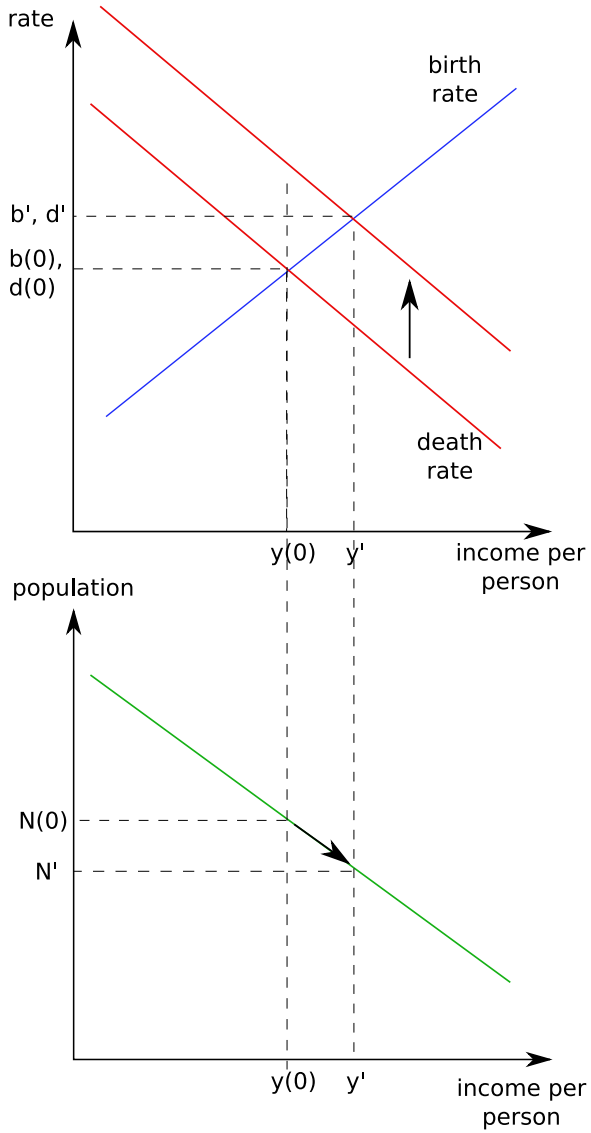


The Effects of a Change in the Birth or Death Schedules

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



The Effects of Change in the Birth or Death Schedules

Now let's think about a shift in the birth schedule. Suppose that Viagra finds its way to a preindustrial economy:

- There will be an increase in births at any given income level, shifting the birth rate curve up
- At the current income per person, births now outnumber deaths and population will grow
- As the population grows, income per person will start to fall until births once again equal deaths
- The economy will end up in a new equilibrium with a lower income per person and a higher population than the old equilibrium

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

Subsistence income in the Malthusian World

Features of a society that would lead to a higher subsistence income:

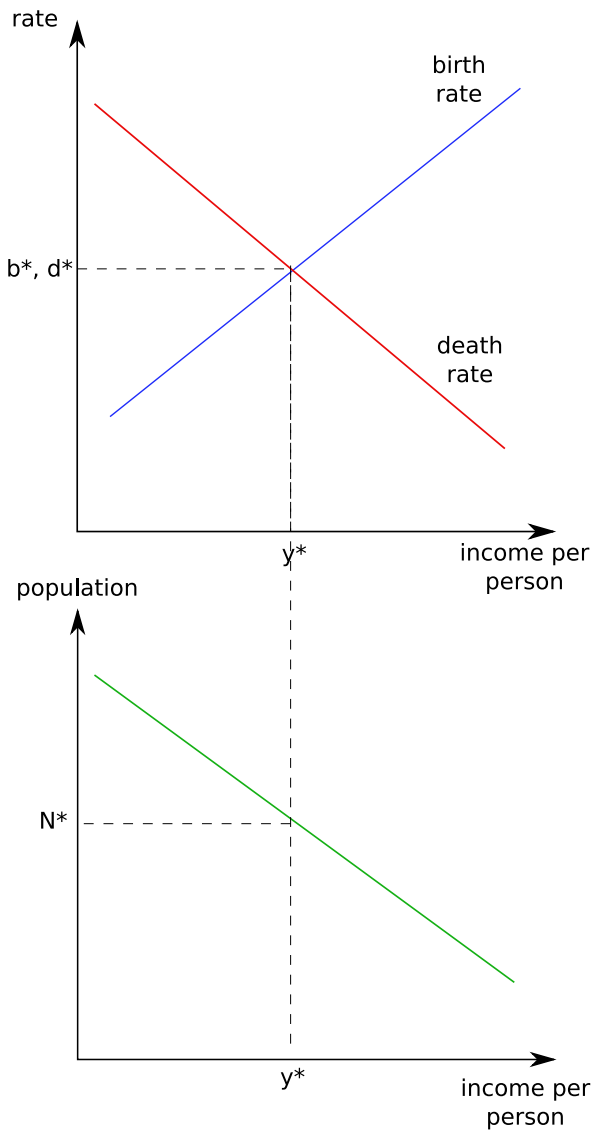
- Low fertility rates:
  - Late age at first marriage
  - Small families being a social norm
  - Greater diffusion of contraceptive practices
- High death rates:
  - Bad disease environment
  - Poor health practices
  - High levels of violence

Better technology just means greater population density in the long run

Announcements

- The first referee report is due February 16th at 5pm
- The article for the referee report is "The Colonial Origins of Comparative Development" by Acemoglu, Johnson and Robinson
- Submit your referee report by email as a pdf
- Next week we'll be getting to the Industrial Revolution, the relevant readings are:
  - Mokyr, Joel (2008), "The Contribution of Economic History to the Study of Innovation and Technical Change", in *Handbook of the Economics of Innovation*
  - De Vries, Jan (1994), "The Industrial Revolution and the Industrious Revolution", *Journal of Economic History*

The Malthusian Equilibrium



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The Neolithic Revolution

- Arguably the biggest technological change in history is the switch from hunting and gathering food to growing our food
- What led to this transition (other than luck)?
  - Decline in availability of wild foods
  - Increase in range of domesticable wild plants
  - Improvements in food technology
  - Population pressure

The Domestication of Plants

Wheat and barley are domesticated in the fertile crescent around 8,000 BC. They were edible, gave high yields, could be easily and quickly grown and could be stored.

The Domestication of Plants

Fruit and nut trees are domesticated around 4,000 BC. They took a long time to yield food and therefore could only be grown by societies already committed to settled village life. An advantage was that they could be grown from cuttings.

The Domestication of Plants

A later stage of plant domestication involved fruit trees that required grafting rather than using seed or cuttings. Examples include apples, pears, plums and cherries.

The Domestication of Plants

At the same time as these difficult fruit trees other wild plants became domesticated after appearing as weeds. These crops include rye, oats, turnips, beets, leeks and lettuce.

Who Domesticated Plants?

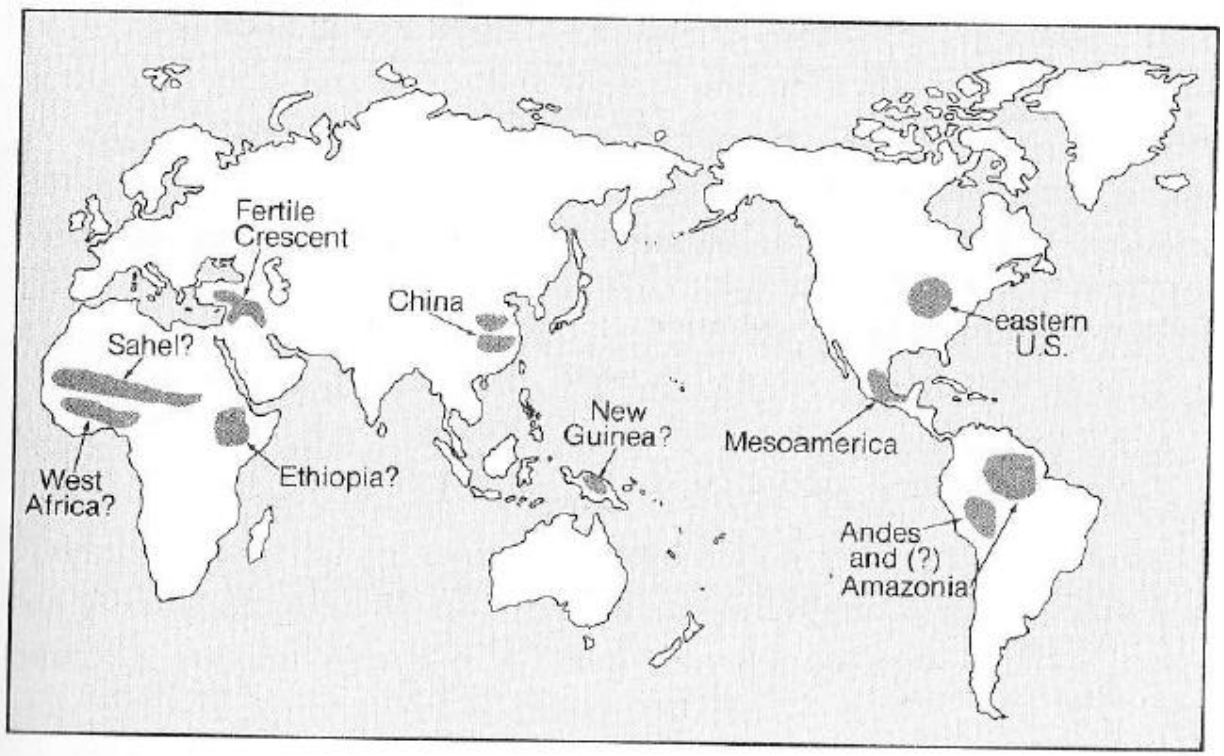


Figure 5.1. Centers of origin of food production. A question mark indicates some uncertainty whether the rise of food production at that center was really uninfluenced by the spread of food production from other centers, or (in the case of New Guinea) what the earliest crops were.

The Neolithic Revolution

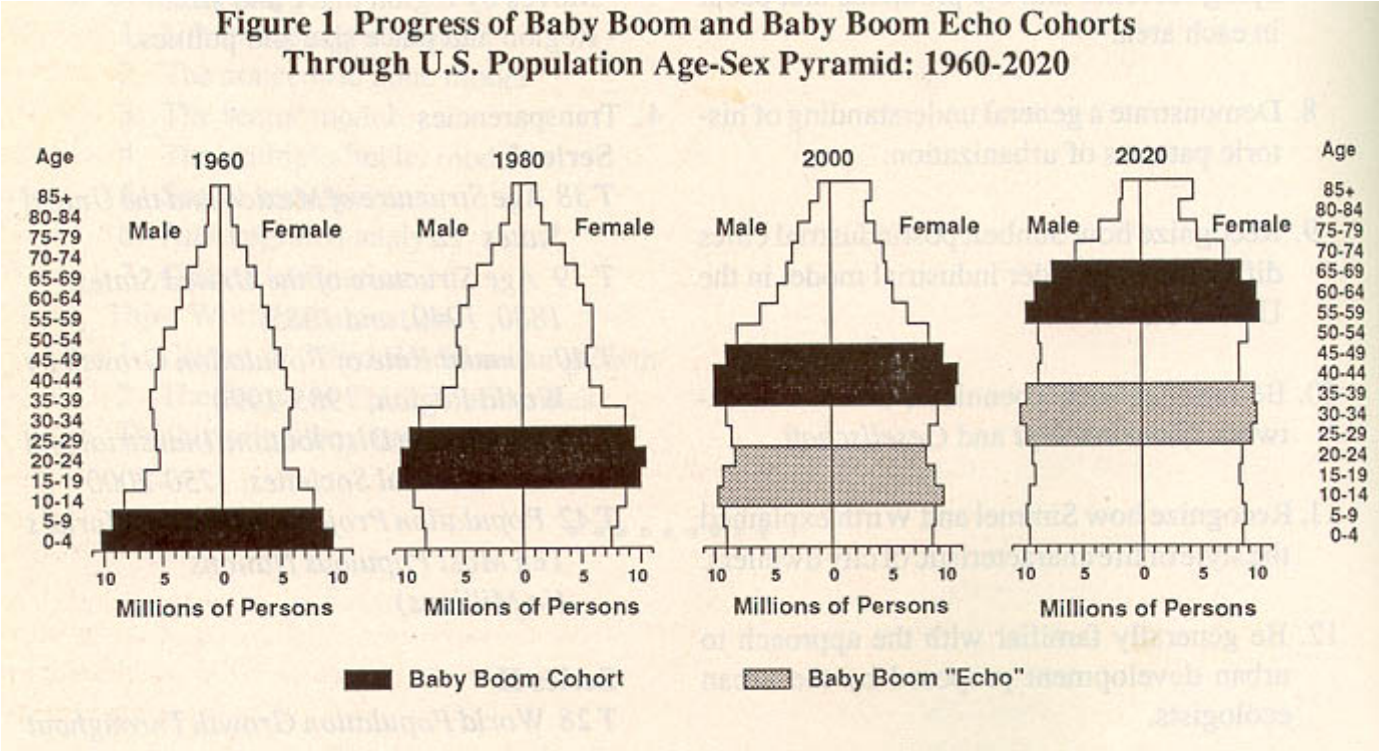
So why am I claiming switching to farming may be the biggest technological change ever?

- Food per acre is dramatically increased: direct impact on $f(K, L, Z)$ and $N(y)$
- Leads to seasonally pulsed inputs of labor
- Food surpluses allow for economic specialization and social stratification
- Sedentary living and the ability to accumulate possessions and commit to projects with longer time horizons
- Denser societies lead to new social and political institutions

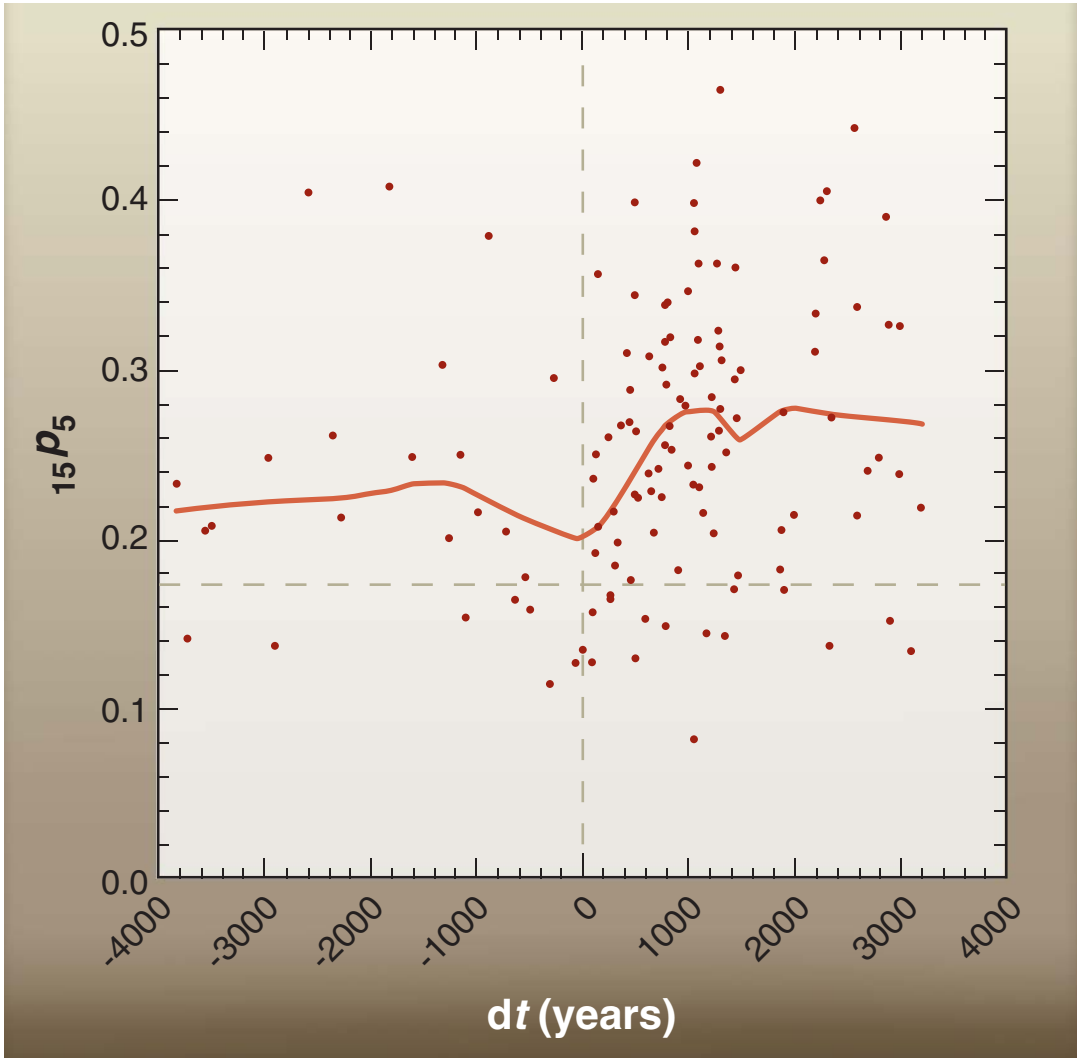
The Neolithic Revolution

- In the context of our Malthusian model of the pre-industrial world, a few things should happen
- The big, big thing is an upward shift in the technology curve
- The rise in income per person should lead to more births and fewer deaths in the short run
- We should get population growth until income per capita falls back to subsistence levels and birth and death rates return to equilibrium levels

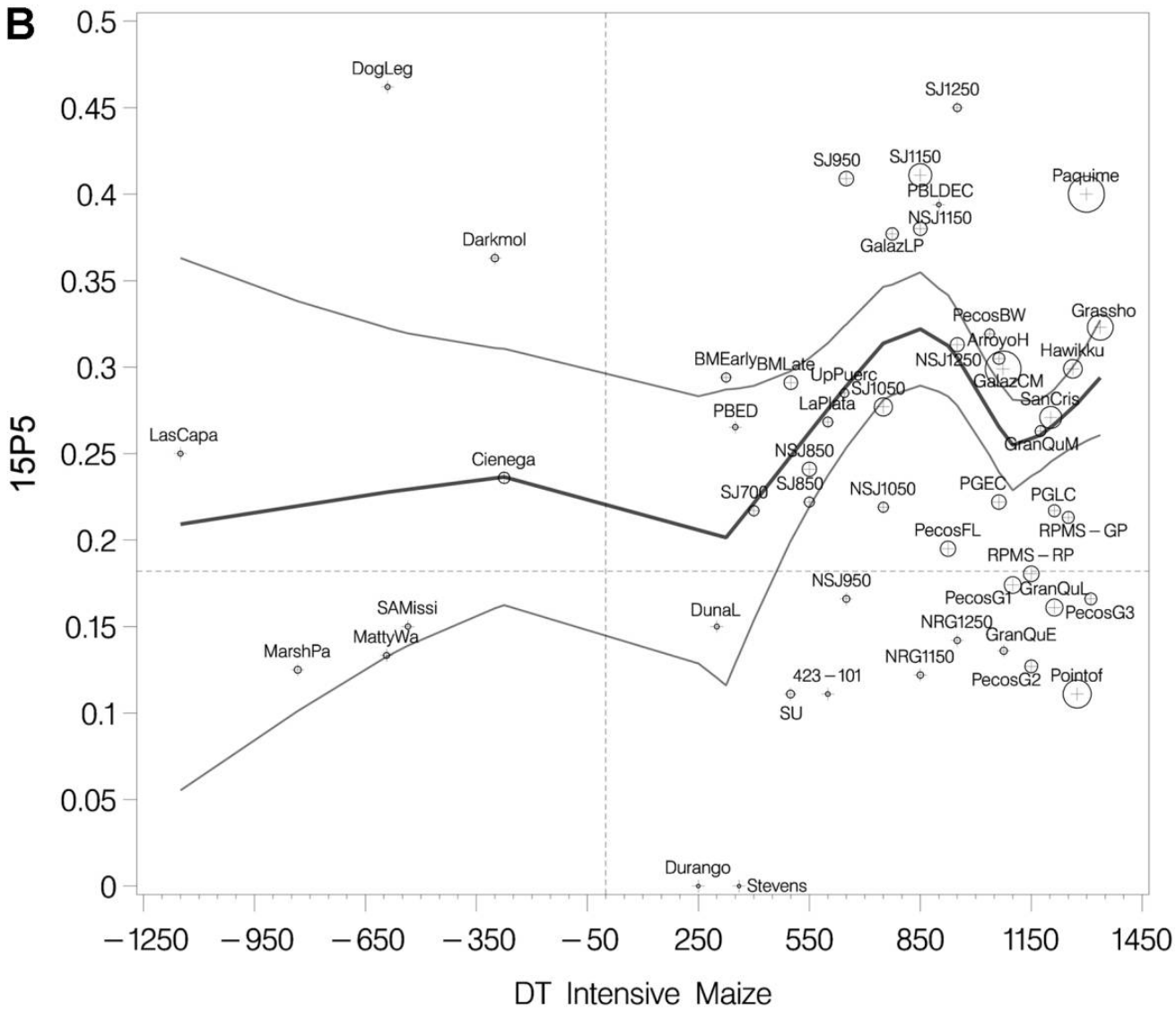
The Neolithic Revolution



The Neolithic Revolution



The Neolithic Revolution



The Neolithic Revolution

- As expected, we see the number of births rise
- Also as expected, populations density gets much bigger (pre-farming world population was about 6 million)
- Also as expected, population growth falls back to very low levels (0.1% per year)
- However, the fertility rate doesn't fall back down in the way our model predicts
- What can explain this?
  - The model is wrong (always a possibility)
  - The death rate curve changed

The Neolithic Revolution

Diseases and Domesticated Animals

Human disease	Animal with closely related pathogen
Measles	cattle
Tuberculosis	cattle
Smallpox	cattle
Flu	pigs and ducks
Pertussis	pigs and dogs
Falciparum malaria	birds

The Neolithic Revolution

- There is one last big thing we'd like to check
- The key result of our model is that technological change leads to higher population density but not a permanent increase in the standard of living
- We have discussed the population part of this
- How can we assess the standard of living?
- Bones are of limited help here but the good news is we actually have a modern data source

The Neolithic Revolution and Living Standards

Daily calories and protein per capita

Group	Period	Kilocalories	Grams of protein
England, farm laborers	1787-96	1,508	27.9
Enland, all	1787-96	2,322	48.2
Belgium, all	1812	2,248	--
Ache, Paraguay	1980s	3,827	--
Alyware, Australia	1970s	3,000	--
Onge, Andaman Islands	1970s	2,620	--
Aruni, New Guinea	1966	2,390	--
!Kung, Botswana	1960s	2,355	--
Bayano Cuna, Panama	1960-61	2,325	49.7
Mbuti, Congo	1970s	2,280	--
Anbarra, Australia	1970s	2,050	--
Hiwi, Venezuela	1980s	1,705	64.4
Shipibo, Peru	1971	1,665	65.5
Yanomamo, Brazil	1974	1,452	58.1

The Neolithic Revolution and Living Standards

Male Labor Hours per Day

Group or location	Group or activity	Hours
Tatuyo	shifting cultivation, hunting	7.6
Mikea	shifting cultivation, foraging	7.4
Ache	hunting	6.9
Abelam	subsistence agriculture, hunting	6.5
!Kung	foraging	6.4
Machiguenga	shifting cultivation, foraging, hunting	6
Xavante	shifting cultivation, hunting	5.9
Aruni	subsistence agriculture	5.2
Mekranoti	shifting cultivation, foraging, hunting	3.9
Shipibo	subsistence agriculture, fishing	3.4
Bemba	shifting cultivation, hunting	3.4
Hiwi	hunting	3
Yanomamo	shifting cultivation, foraging, hunting	2.8
Britain, 1800	farm laborers, paid labor	8.2
London, 1800	all workers, paid labor	9.1
United Kingdom, 2000	all workers aged 16-64	8.8

The Neolithic Revolution and Living Standards

Heights of Adult Males

Period	Location	Type	Height (cm)
1830s	England	soldiers	169
1830s	Northern Italy	soldiers	167
1830s	France	soldiers	167
1830s	Austria	soldiers	164
1830s	Mozambique	slaves	165
1820s	Southern China	convicts	164
1880s	Japan	soldiers	159
1892	United States	Plains Indians	172
1970s	Australia	Anbarra	172
1944	Tanzania	Sandawe	167
1969	Botswana	!Kung	163
1980s	Paraguay	Ache	163

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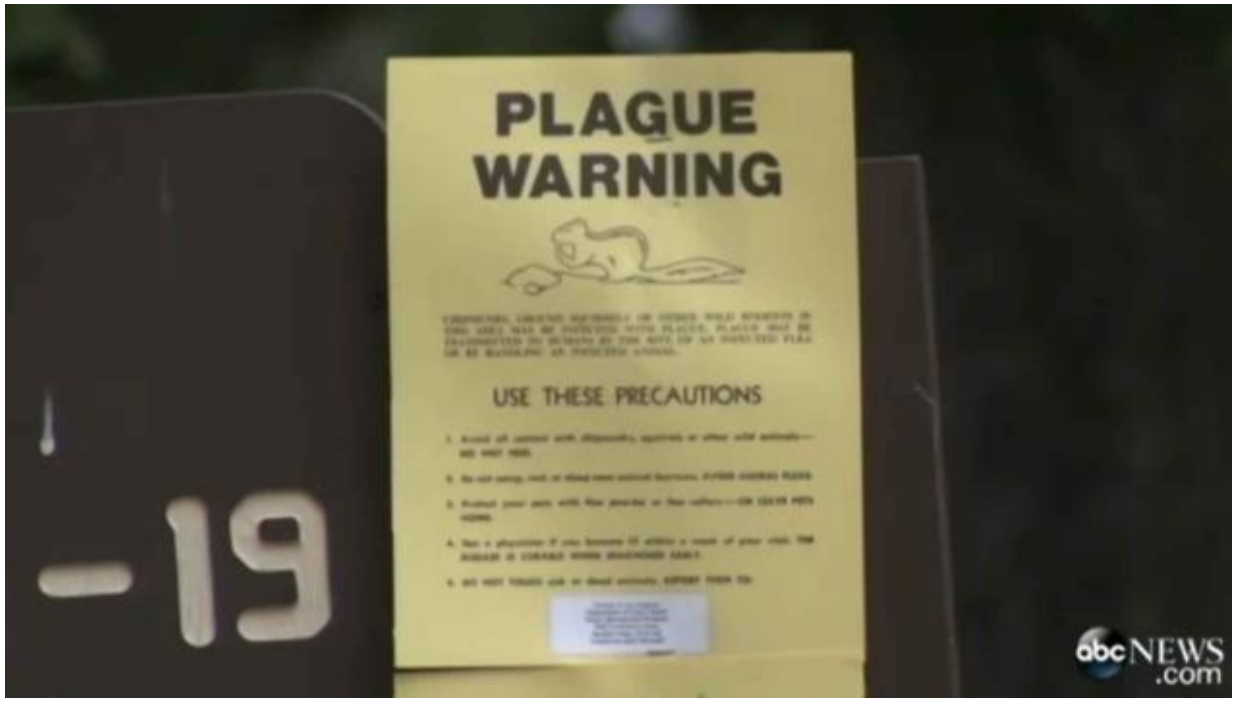
The Black Death

The Black Death

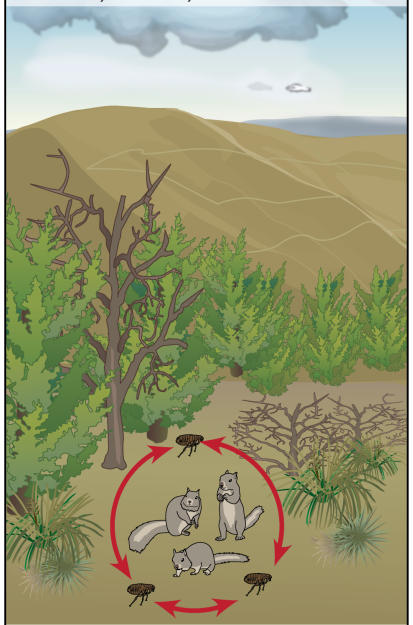


The Black Death

Plague Ecology in the United States

Plague in Nature

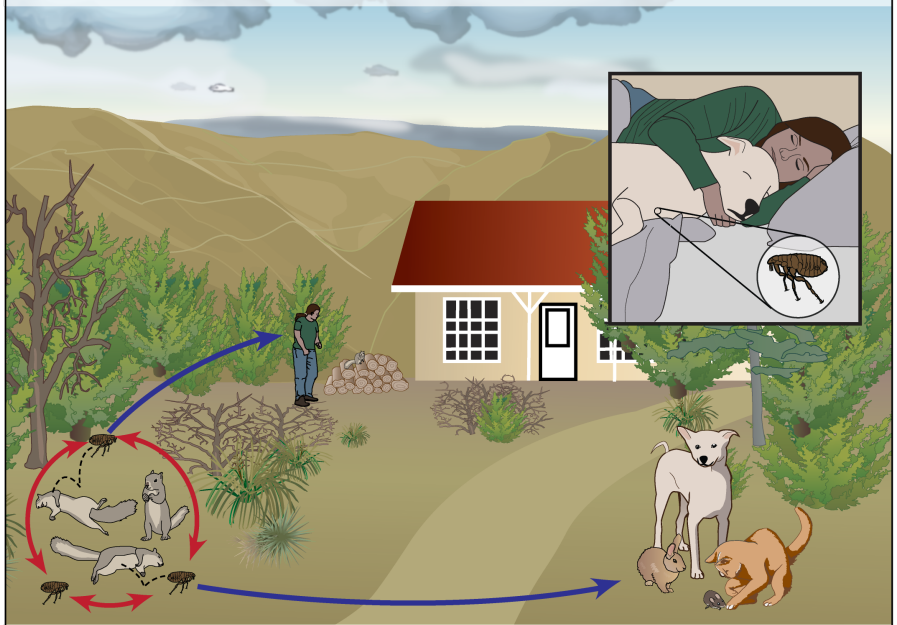
Plague occurs naturally in the western U.S., especially in the semi-arid grasslands and scrub woodlands of the southwestern states of Arizona, Colorado, New Mexico and Utah.



The plague bacterium (*Yersinia pestis*) is transmitted by fleas and cycles naturally among wild rodents, including rock squirrels, ground squirrels, prairie dogs and wood rats.

Plague in Humans

Occasionally, infections among rodents increase dramatically, causing an outbreak, or epizootic. During plague epizootics, many rodents die, causing hungry fleas to seek other sources of blood. Studies suggest that epizootics in the southwestern U.S. are more likely during cooler summers that follow wet winters.



Humans and domestic animals that are bitten by fleas from dead animals are at risk for contracting plague, especially during an epizootic. Cats usually become very ill from plague and can directly infect humans when they cough infectious droplets into the air. Dogs are less likely to be ill, but they can still bring plague-infected fleas into the home. In addition to flea bites, people can be exposed while handling skins or flesh of infected animals.

CS225948

The Black Death

- The black death plagued Europe in the fourteenth century
- Estimates of the deaths from the plague range from 74 to 200 million (world population was only about 450 million)
- It took the population 150 years to recover
- So what does our model predict?

The Black Death

- First, we need to think about whether to consider the plague a one time shock to population or a shift to the death rate curve
- One time shock to population:
  - $\Delta N < 0$ leads to $\Delta y > 0$
  - Higher y leads to more births, fewer deaths until we return to the same subsistence y and population as before
- Shift in the death rate curve:
  - Once shifted, deaths exceed births
  - Population shrinks and income rises
  - Deaths fall and births rise until we reach a new, smaller N with a new, higher y

The Black Death

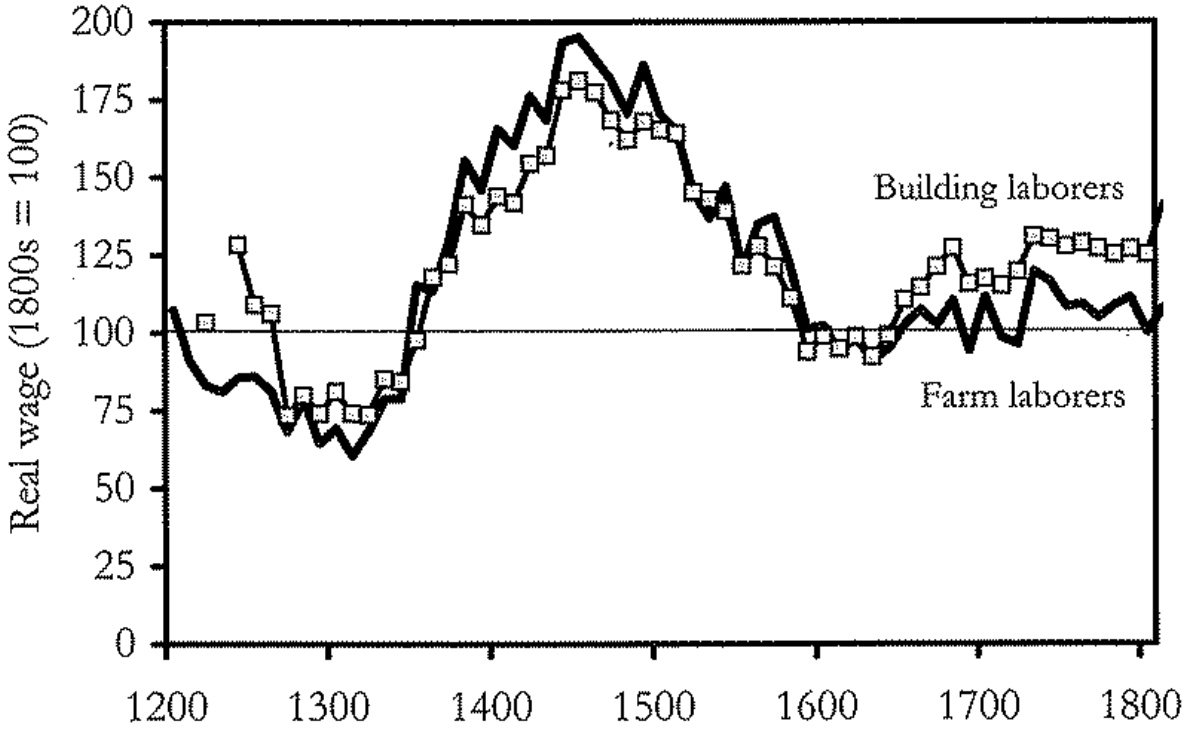
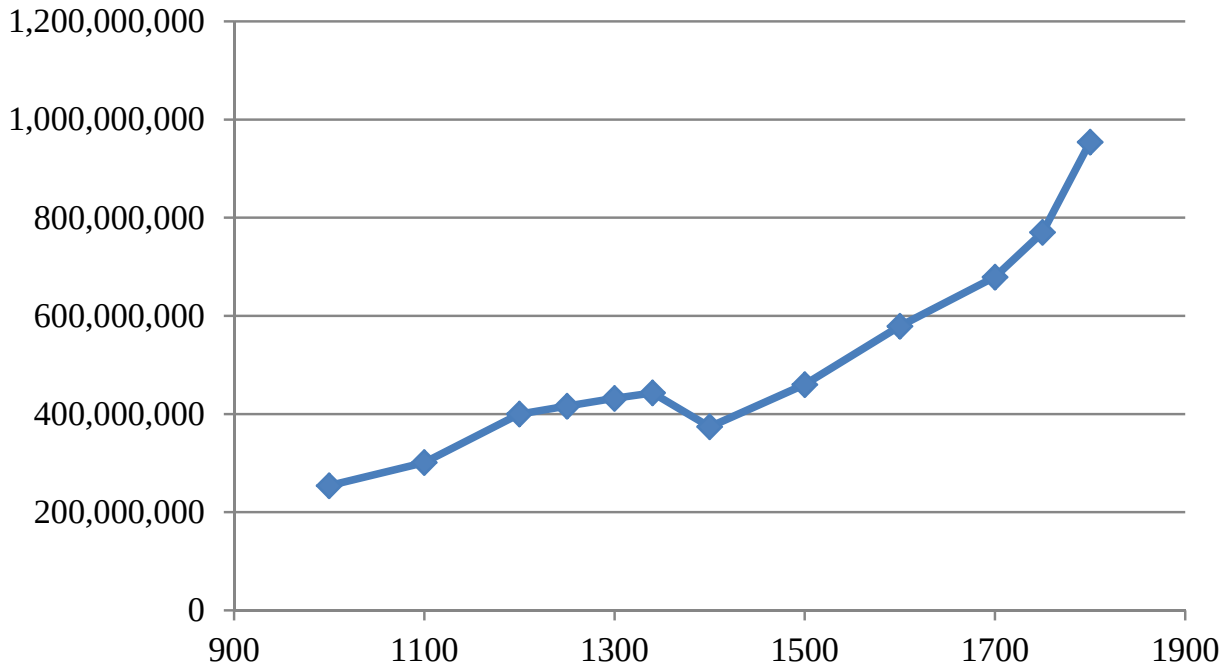


Figure 3.1 English laborers' real wages, 1209–1809.

The Black Death



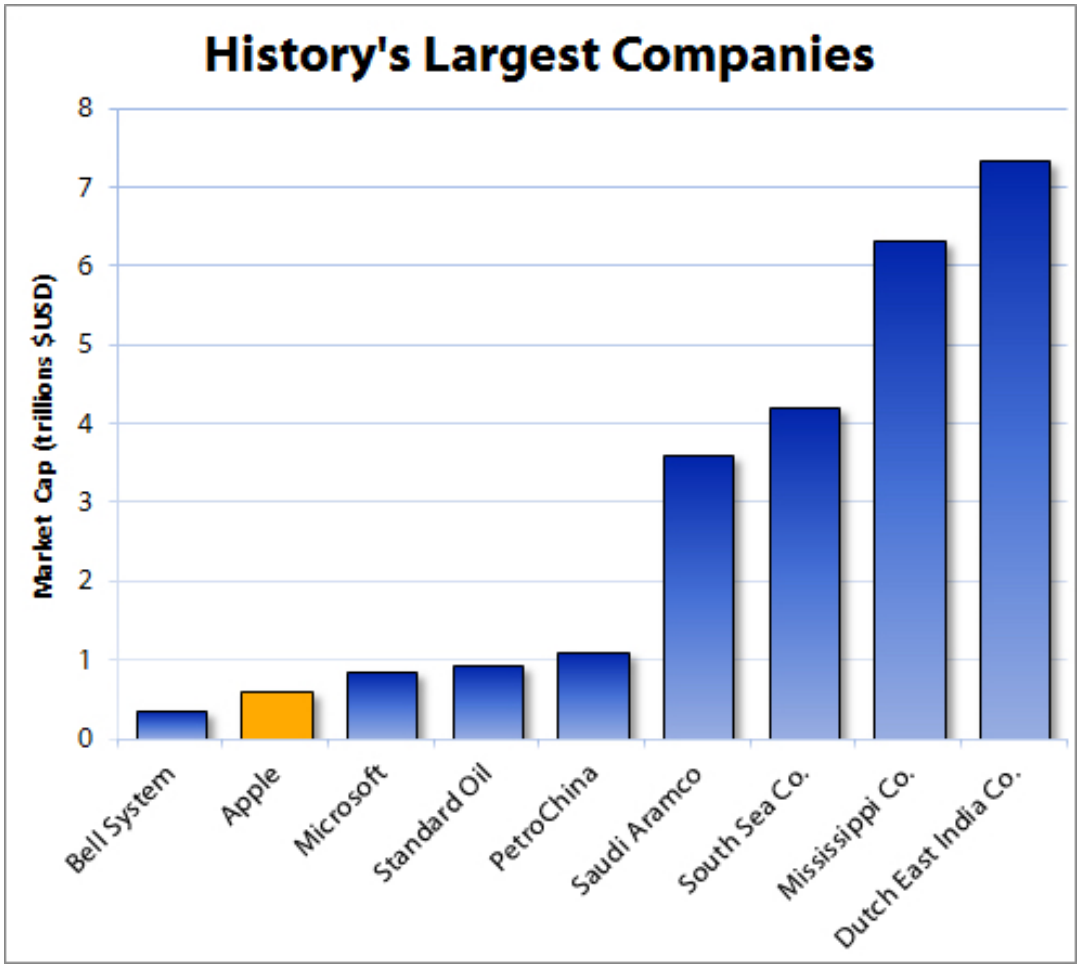
World population over time, Biraben (1980)

The Dutch Golden Age

The Dutch Golden Age

- For one last example, let's turn to the Dutch Golden Age
- In the 1600s, the Netherlands experienced several shocks:
  - An influx of skilled workers
  - Advances in power and shipbuilding technology
  - The development of modern commercial and financial institutions
- This era saw the rise of the Dutch East India Company, an economic behemoth employing pretty modern business approaches

The Dutch Golden Age



From http://www.fool.com/investing/general/2012/08/22/a-history-of-ridiculously-big-companies.aspx

The Dutch Golden Age

Jan Brueghel the Younger, Satire on Tulip Mania, c. 1640

The Dutch Golden Age

- So what does our model predict?
- The financial innovations, the opening of international trade routes, and everything else allowed for substantially higher GDP per capita
- But our Malthusian model says this should be short lived
- Population growth will ultimately eat away at the increases in GPP per capita
- We'll return to subsistence income, just at a larger population
- What do we see in the data?

The Dutch Golden Age

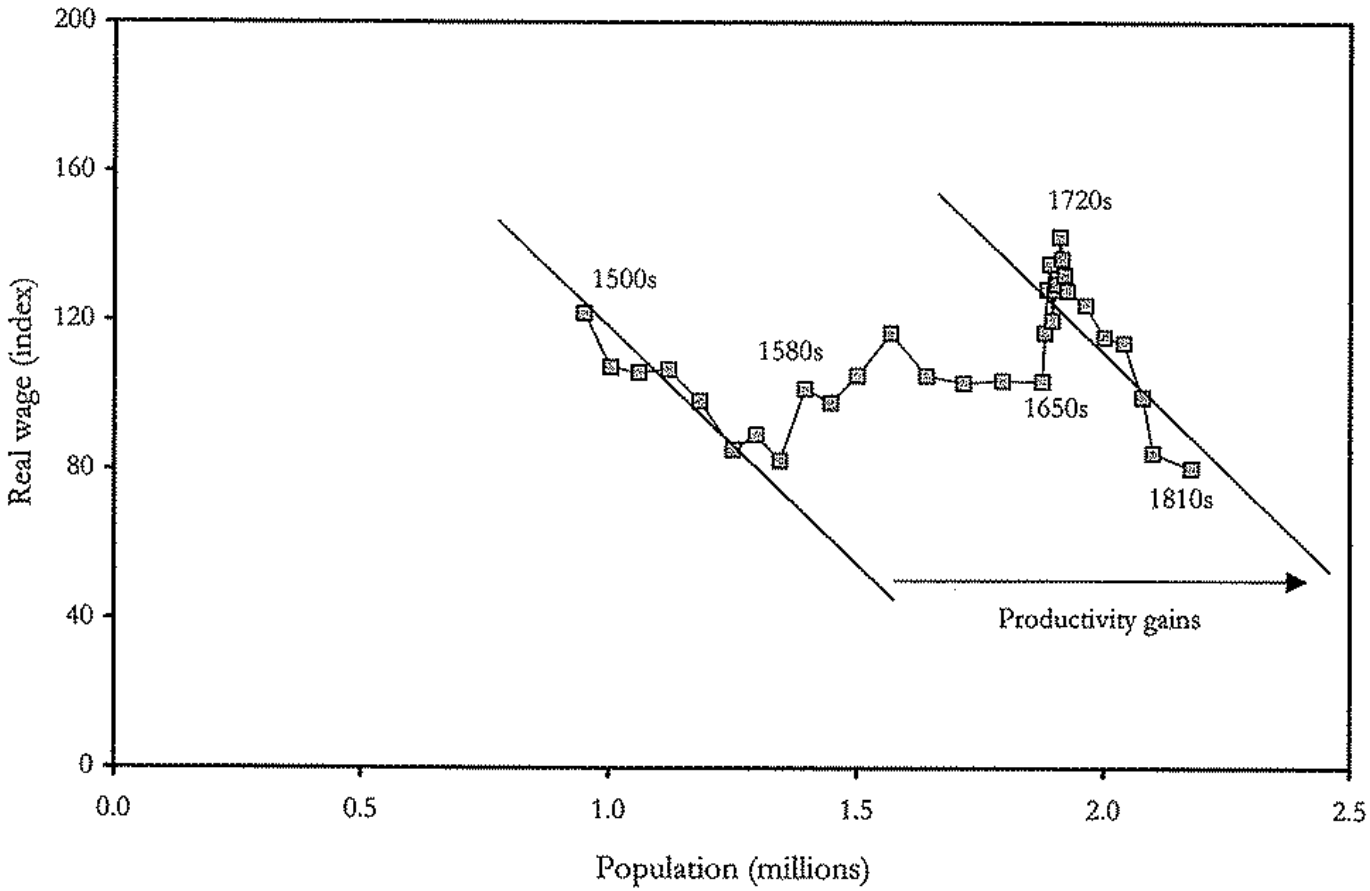


Figure 5.5 Real wages versus population in the Netherlands, 1500s–1810s.

How to Think of Living Standards

A few things to keep in mind with these examples:

- Are we really measuring standard of living in the right way?
- What about the bigger communities and more stable lifestyles brought about by the Neolithic Revolution?
- What about the emotional toll of the plague?
- What about the variety of goods provided by the Dutch expansion of international trade?
- What about the distribution of income? Is the focus on income per capita useful?

Cross-Country Differences in the Preindustrial World

- So it seems the Malthusian trap influenced everyone (on average)
- But that doesn't mean everyone had the same subsistence wage
- Differences in fertility and mortality could lead to large differences in subsistence income from one country to the next
- In particular, northwestern Europe enjoyed a higher subsistence income than east Asia

Cross-Country Differences in the Preindustrial World

Laborer's Wages in Wheat Equivalents, 1800

Location	Day wage (pounds of wheat)
Amsterdam	21
London	16
Antwerp	16
Cairo	15
England	13
Warsaw	13
England (farmers)	11
Vienna	10
Paris	10
Madrid	9
China	6.6
Korea	6
South India	5.1
Japan	4.5

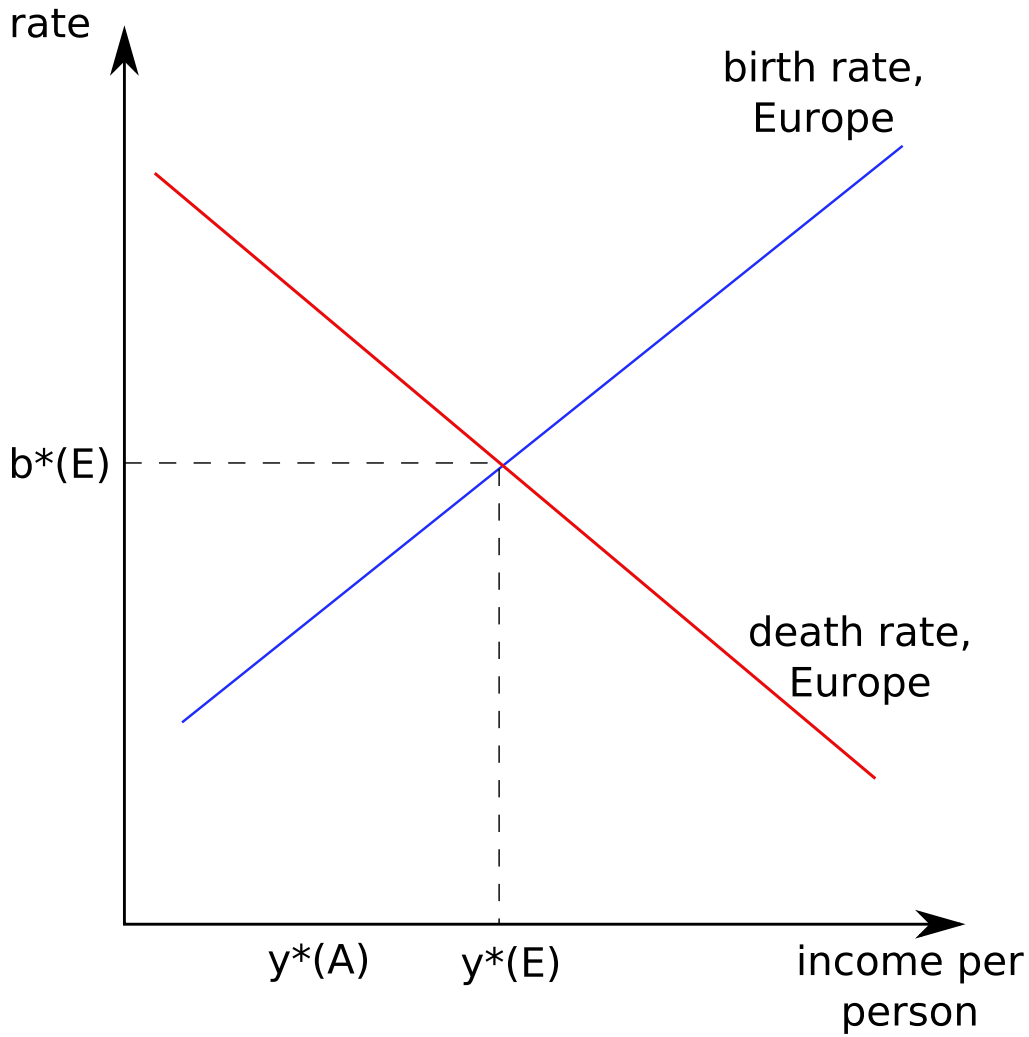
Explaining the Europe-Asia Difference

- If Europe had a higher subsistence income than Asia, it would have been due to either a difference in the birth rate curve, the death rate curve, or both
- Let's start by looking at fertility rates
- European birth rates were low relative to the theoretical maximum (English women had an average of about 8 children, about 3 less than theoretically possible)
- What made European birth rates low? delayed marriage, decisions not to marry, few kids born outside of marriage

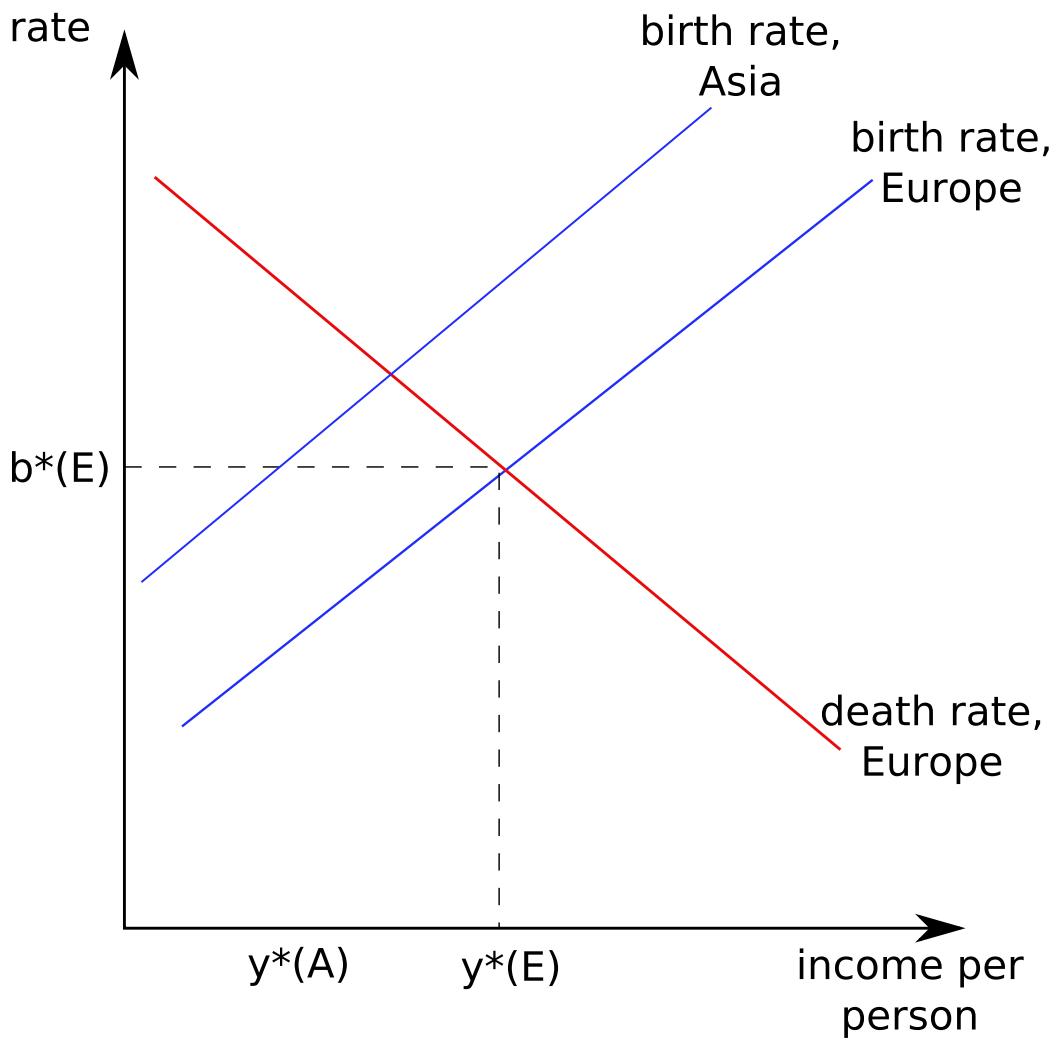
Explaining the Europe-Asia Difference

- So do differences in the birth rate curve explain the differences in standard of living?
- Not entirely
- Asian birth rates were also well below the theoretical maximum (although for different reasons)
- The actual equilibrium birth rate ended up being similar between eastern Asia and northwestern Europe
- So something had to be going on with death rates as well

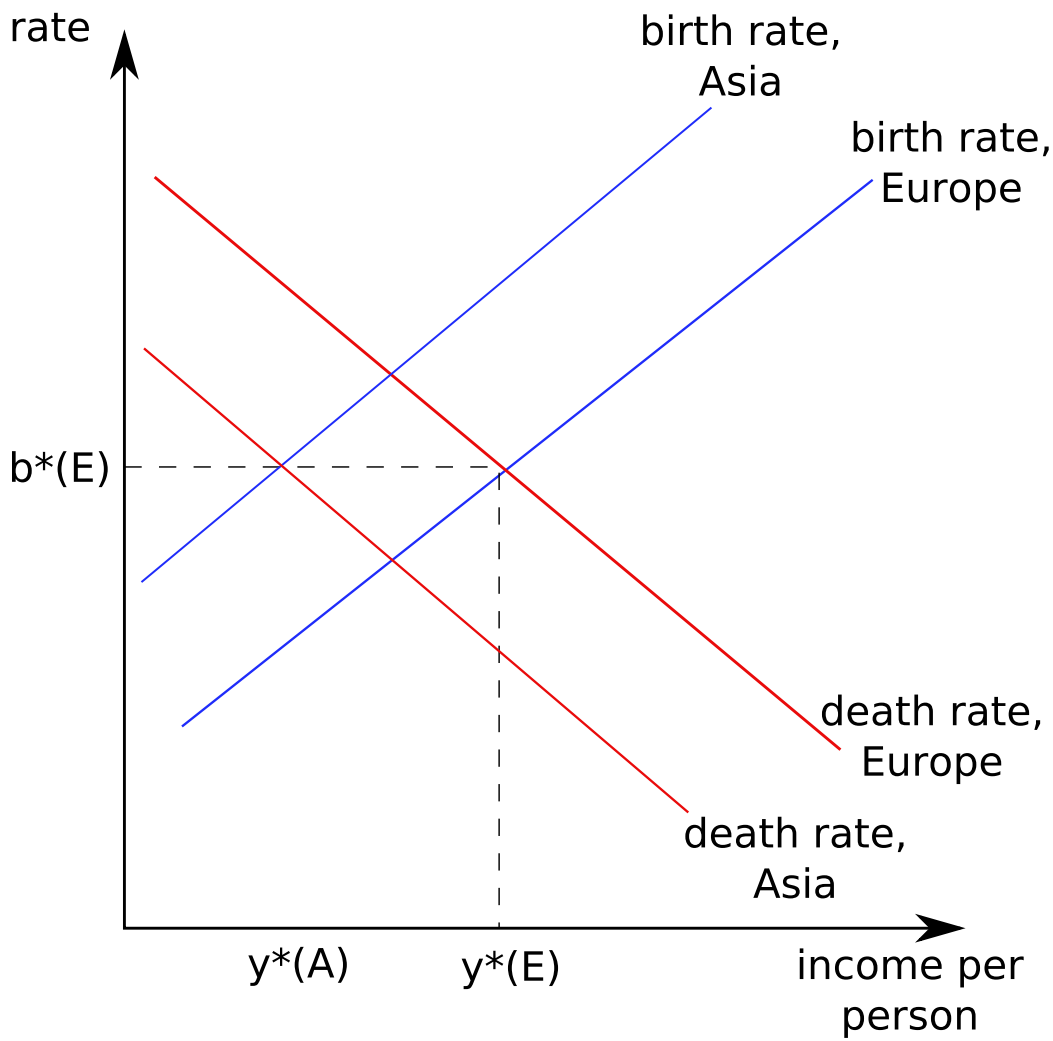
Explaining the Europe-Asia Difference



Explaining the Europe-Asia Difference



Explaining the Europe-Asia Difference



Explaining the Europe-Asia Difference

- So it looks like Europe's higher income was due in part to a higher death rate curve
- Why would these European countries have high mortality rates?
  - Urbanization - lots of people close together is bad for health
  - Colonial adventure (discovering new things to kill you)
  - Poor health practices (sewage, filth, etc.)

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Explaining the Europe-Asia Difference

"A dirtier or more wretched place he had never seen. The street was very narrow and muddy, and the air was impregnated with filthy odours...Covered ways and yards, which here and there diverged from the main street, disclosed little knots of houses where drunken men and women were positively wallowing in the filth..."

–Charles Dickens, Oliver Twist

Explaining the Europe-Asia Difference

"In the first jaws appeared that ugly monster Ycleped Mud, which when their oars did once stir, Belched forth an air as hot as at the muster Of all your night-tubs, when the carts do cluster, Who shall discharge first his merd-urinous load: Thorough her womb they make their famous road Between two walls, where on one side, to scar men Were seen your ugly centaurs ye call car-men, Gorgonian scolds and harpies; on the other Hung stench, diseases, and old filth, their mother, With famine, wants and sorrows many a dozen, The least of which was to the plague a cousin. But they unfrighted pass, though many a privy Spake to 'em louder than the ox in Livy, And many a sink poured out her rage anenst 'em; But still their valour and their virtue fenced 'em, And on they went, like Castor brave and Pollux, Ploughing the main."

–Ben Jonson, On the Famous Voyage, 1612

Explaining the Europe-Asia Difference

"Mr. John Kennedy, in the course of examinations...asked one of them: 'How often do the drawers wash their bodies?' 'None of the drawers ever wash their bodies. I never wash my body; I let my shirt rub the dirt off...I wash my neck and ears, and face, of course."'

–Edwin Chadwick, Report on the Sanitary Condition of the Labouring Population of Great Britain (1842)

Explaining the Europe-Asia Difference

"Few visitors to Japan fail to remark on the extraordinary Japanese passion for bathing."

–Peter Grilli, Pleasures of the Japanese Bath

Progress Beyond the Standard of Living

- Standard of living in terms of income per capita was not improving much in the Malthusian world
- Technology advanced but this just led to increased population and population density
- But this is just a small set of the things that define an economy
- Some other important aspects of economies were changing over time before the Industrial Revolution, including many things we think of as fundamental to economic growth today

Progress Beyond the Standard of Living

So what was evolving in centuries leading up to Industrial Revolution?

- The security of property and personal security
- Complete and competitive markets
- Interest rates (and time preference rates)
- Work habits
- Human capital

Security of Private Property

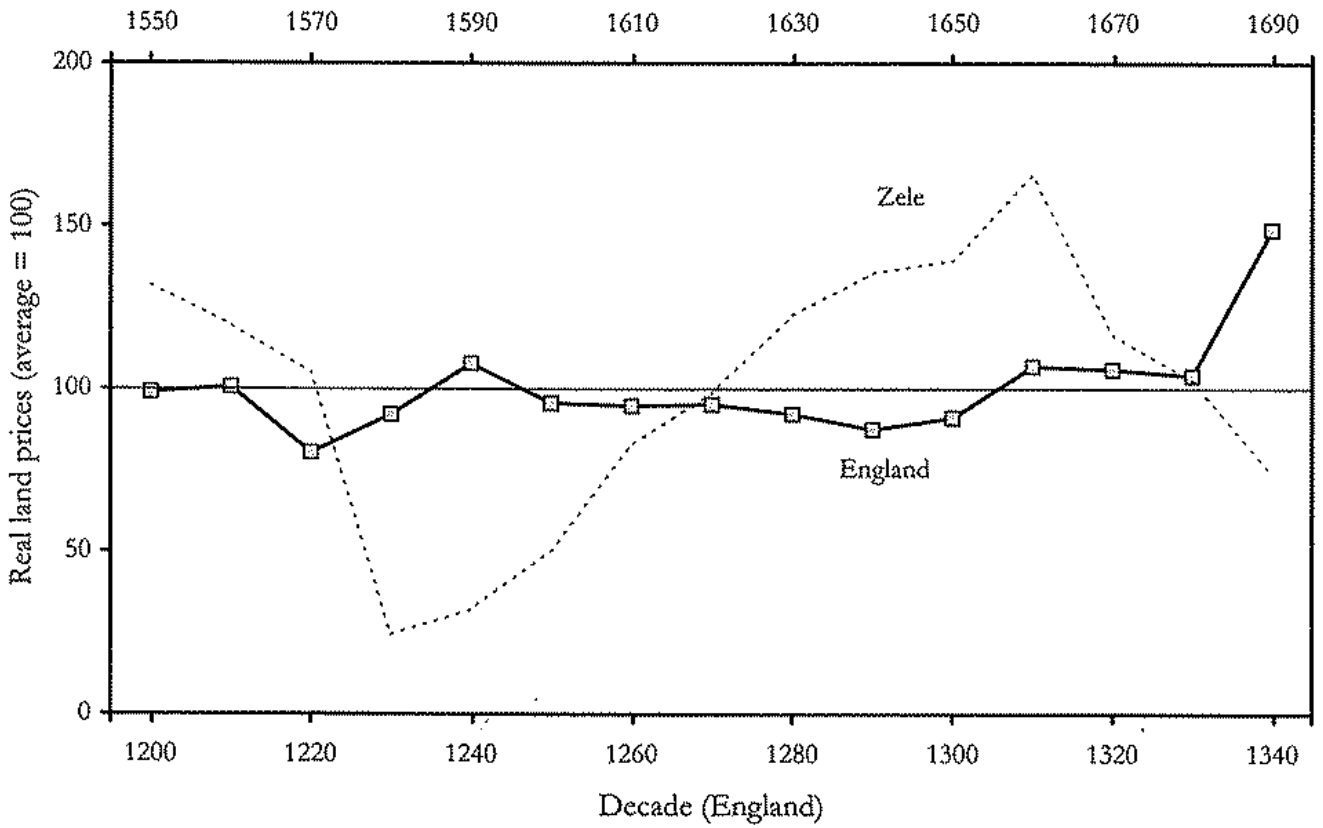

Figure 8.9 Real farmland prices in England, 1200–1349, and in Zele, 1550–1699. Prices for Zele from Clark, 1996.

Personal Security - The Big Picture

Skull of Towton 25
http://www.economist.com/node/17722650

Personal Security - The Big Picture

Distribution of Skeletons in the Western Hemisphere Database

	Native American				
Period	North America	Middle America	South America	Euro-American	Afro-American
1750+	627	0	0	1201	1380
1500-1749	2580	0	39	113	0
1000-1499	888	236	1095	0	0
1 AD - 999	1642	594	382	0	0
1000 BC - 0 AD	250	0	247	0	0
Before 1000 BC	485	343	418	0	0
Total	6472	1173	2181	1314	1380

Personal Security - The Big Picture

Logit Regression Results Explaining Leg, Arm or Hand Trauma

Variable	Coefficient	P-value	dPr(trauma)/dx
Male	0.3588	0.017	0.0222
Village	0.1459	0.590	0.0087
City	0.1728	0.609	0.0111
1 AD - 1499	0.1627	0.405	0.0101
1500 - 1749	0.1641	0.462	0.0103
1750+	-0.3858	0.211	-0.0207

Personal Security - The Big Picture

Logit Regression Results Explaining Head or Weapon Trauma

Variable	Coefficient	P-value	dPr(trauma)/dx
Male	0.2932	0.019	0.0202
Village	-1.3031	0.000	-0.1043
City	-1.6339	0.000	-0.0720
1 AD - 1499	0.1674	0.358	0.0117
1500 - 1749	0.9963	0.000	0.0842
1750+	0.4426	0.039	0.0345

Personal Security on the Eve of Industrialization

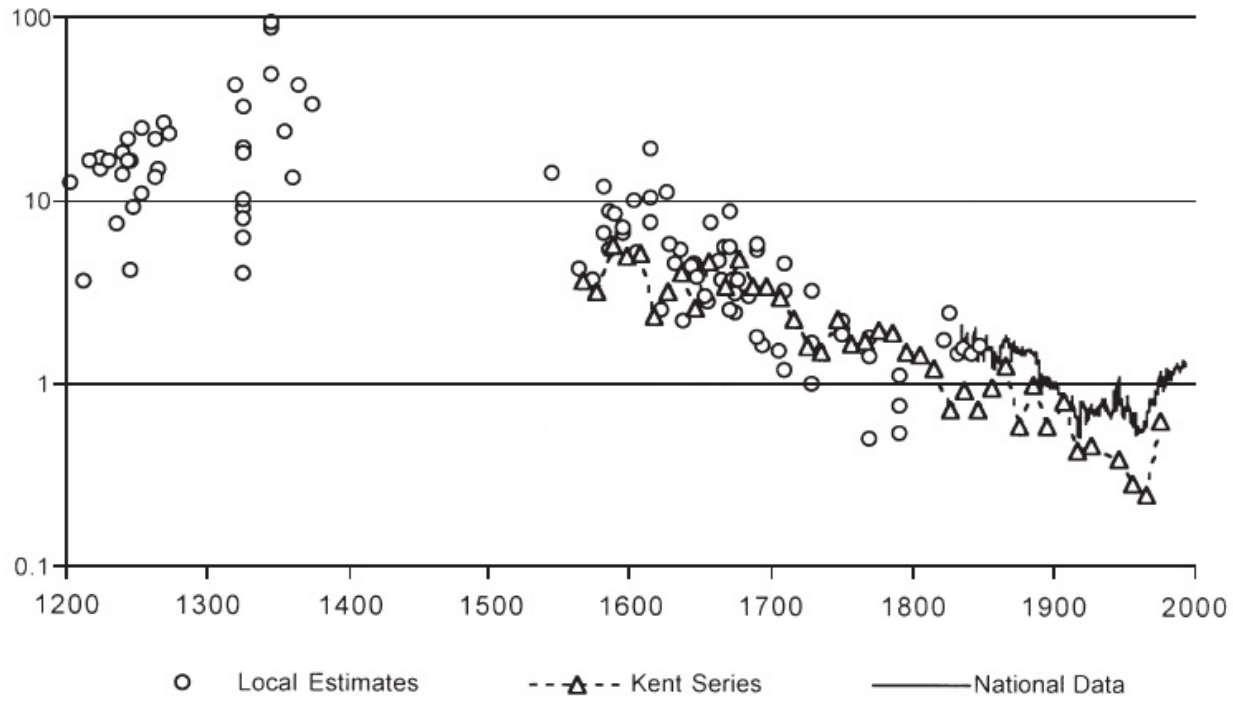

FIG. 1 Homicide rates in England

Homicide rate is number of homicides per 100,000 population

Homicide rate for VA is 3.7 per 100,000 in 2012

Personal Security on the Eve of Industrialization

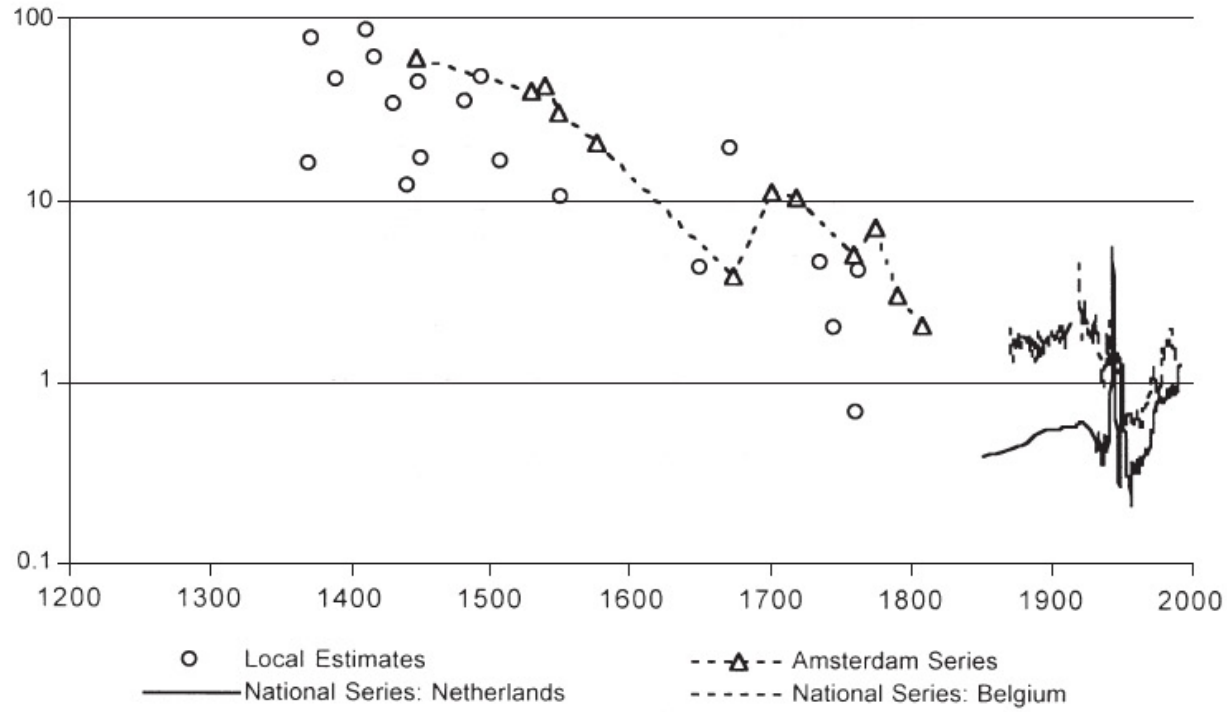

FIG. 2 Homicide rates in Netherlands and Belgium

Homicide rate is number of homicides per 100,000 population

Homicide rate for RVA was 27 in 2007 and 47.3 in 2004

Markets and Market Integration

Interest Rates

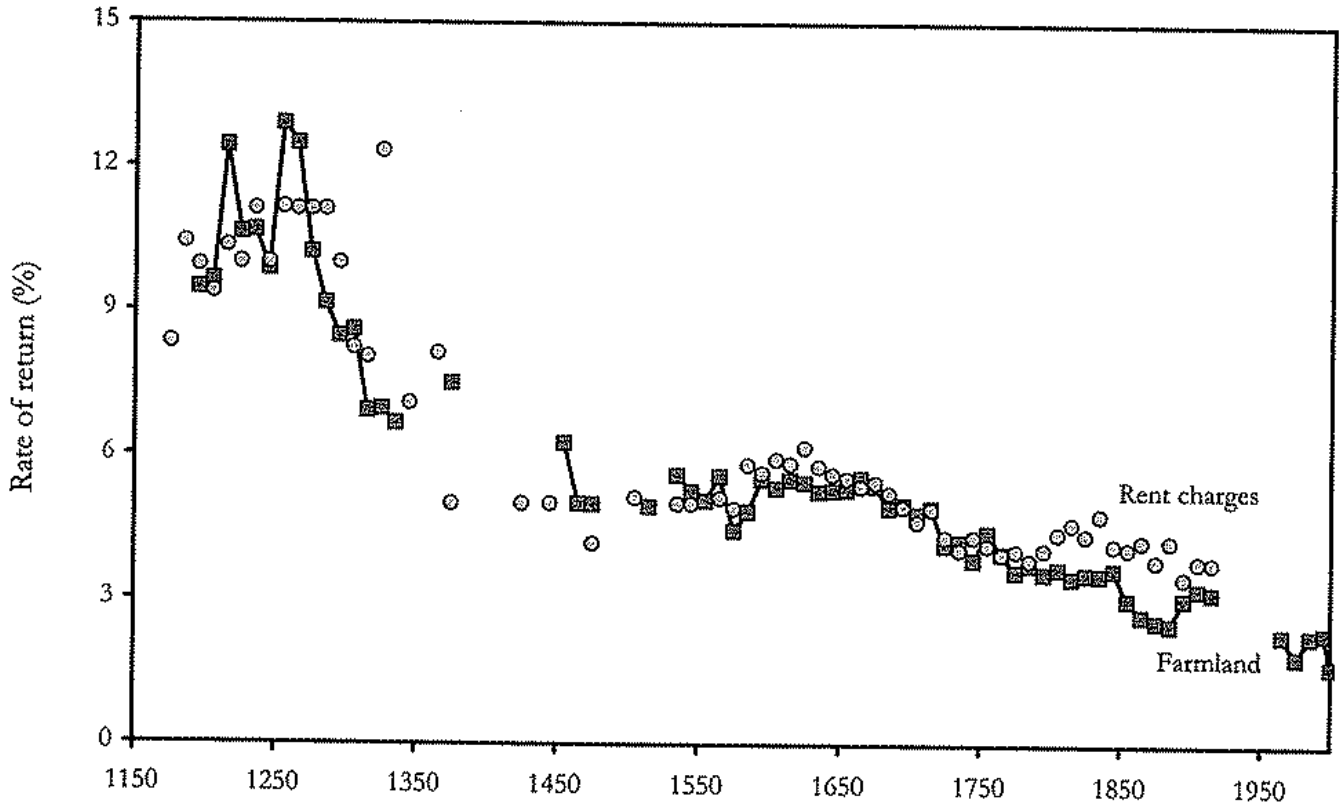

Figure 9.1 Return on land and on rent charges by decade in England, 1170–2003. For the years before 1350 the land returns are the moving average of three decades because in these early years this measure is noisy.

Why did interest rates fall?

$$r = \rho + d + \psi g_y$$

- d - default risk premium, probably didn't fall much from medieval times to the Industrial Revolution
- ψg_y - growth premium, not relevant because there was no sustained growth in income before the Industrial Revolution
- ρ - time preference rate, very high for early societies, people getting more patient could explain fall in interest rates

Work Habits

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Group or location	Group or activity	Hours
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Britain, 1800	farm laborers, paid labor	8.2
London, 1800	all workers, paid labor	9.1
United Kingdom, 2000	all workers aged 16-64	8.8

Human Capital

- Human capital is the set of skills and knowledge a worker possesses
- With the little evidence we have available, it looks like human capital increased in the decades before the Industrial Revolution
- Where does this evidence come from?

Where does this evidence on the education of society come from?

- Not much data out there measuring actual education level
- Can find crude measures of literacy and numeracy which serve as proxies for education
- Still problems with measuring literacy and numeracy
- Indirect evidence comes from the kinds of documents that survive and how many documents survive
- Look at things like how well people could report their ages, whether they could sign their name

Age Heaping

- Age heaping occurs when people round to ages ending in zero or five when estimating their ages.
- If everyone reported age correctly, 20 percent of the population would report an age ending in a zero or five.
- If everyone rounded, 100 percent would report an age ending in a zero or five (20 percent of these people would get lucky and actually be correct).

$$H = \frac{5}{4}(X - 20)$$

- When $X = 20$, $H = 0$ and when $X = 100$, $H = 100$.

Age Heaping

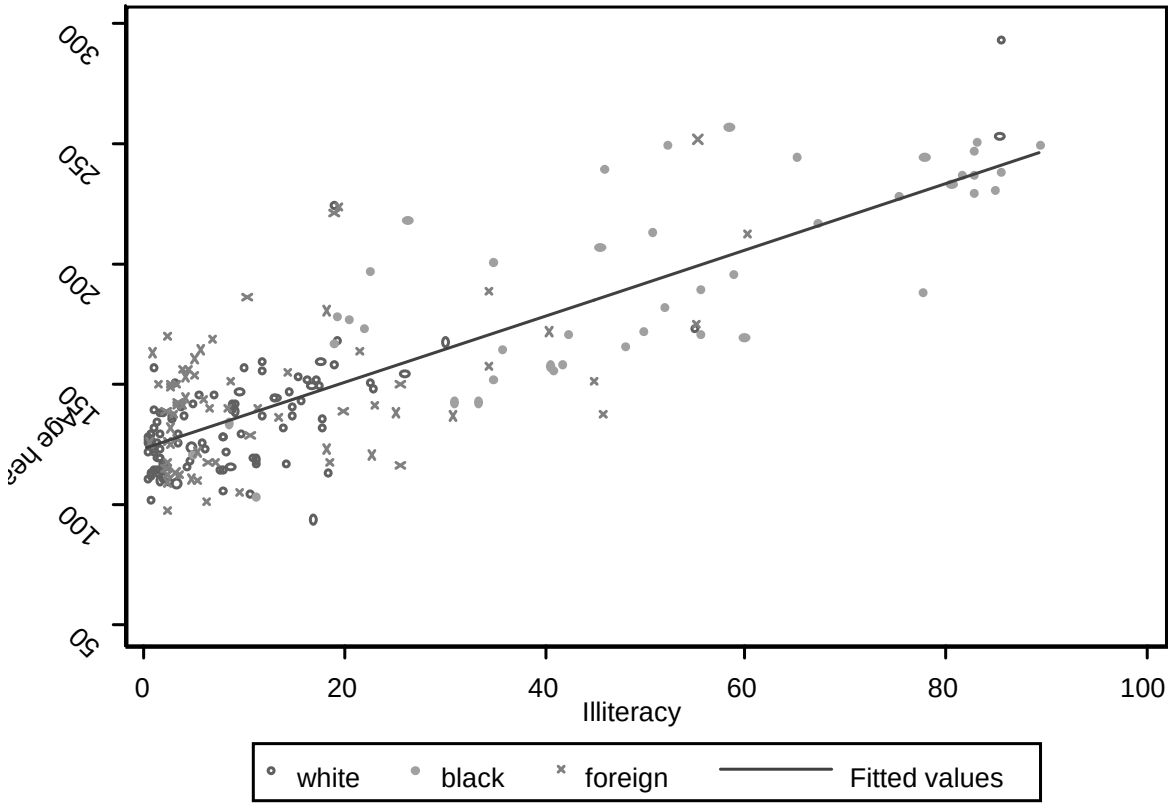
- An alternative measure is the Whipple Index (George Whipple, 1866-1924)
- Focuses on the population between ages 23 and 62
- $Pop_{0,5}$ is the number of people with an age ending in 0 or 5
- Pop_{all} is the total population

$$W = 500 \cdot \frac{Pop_{0,5}}{Pop_{all}}$$

- $W = 100$ when 20 percent have an age ending in 0 or 5
- $W = 500$ when 100 percent have an age ending in 0 or 5

Age Heaping and Illiteracy

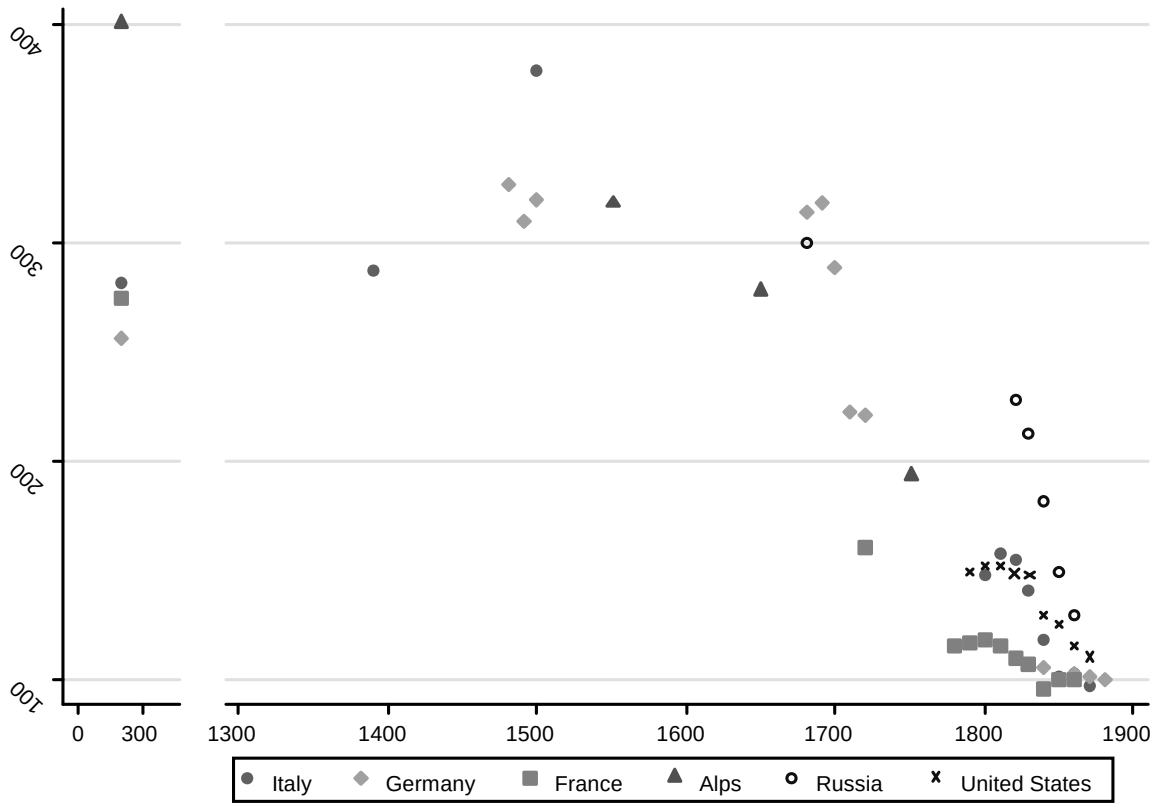
Figure 6. Age heaping and illiteracy in three U.S. censuses



From Hearn, Baten and Crayen, age heaping is measured using the Whipple index, an observation is a state-census year

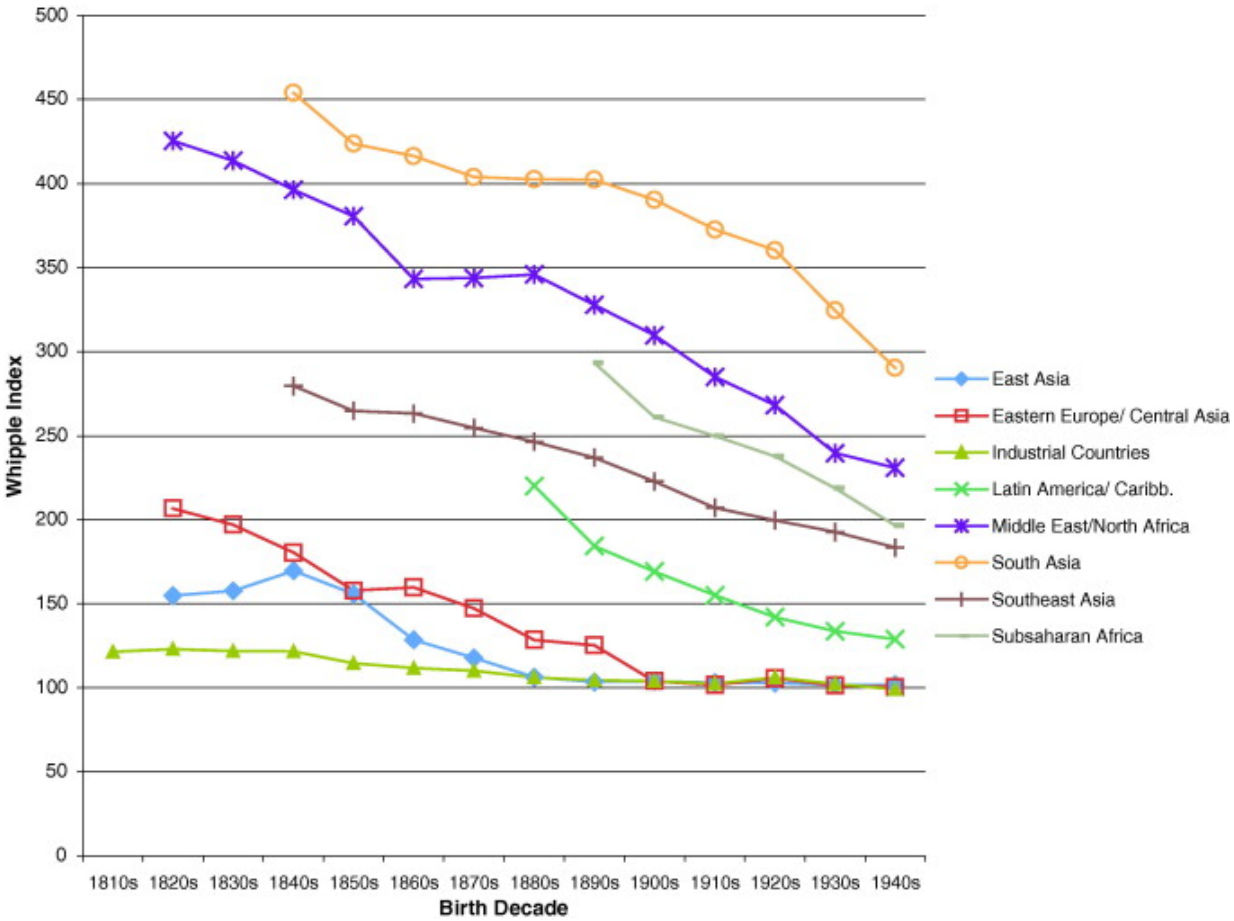
Age Heaping in the Long Run

Figure 7. Age heaping in the long run



From Hearn, Baten and Crayen, age heaping is measured using the Whipple index

Age Heaping by Region



From Crayen and Baten, age heaping is measured using the Whipple index

Human Capital

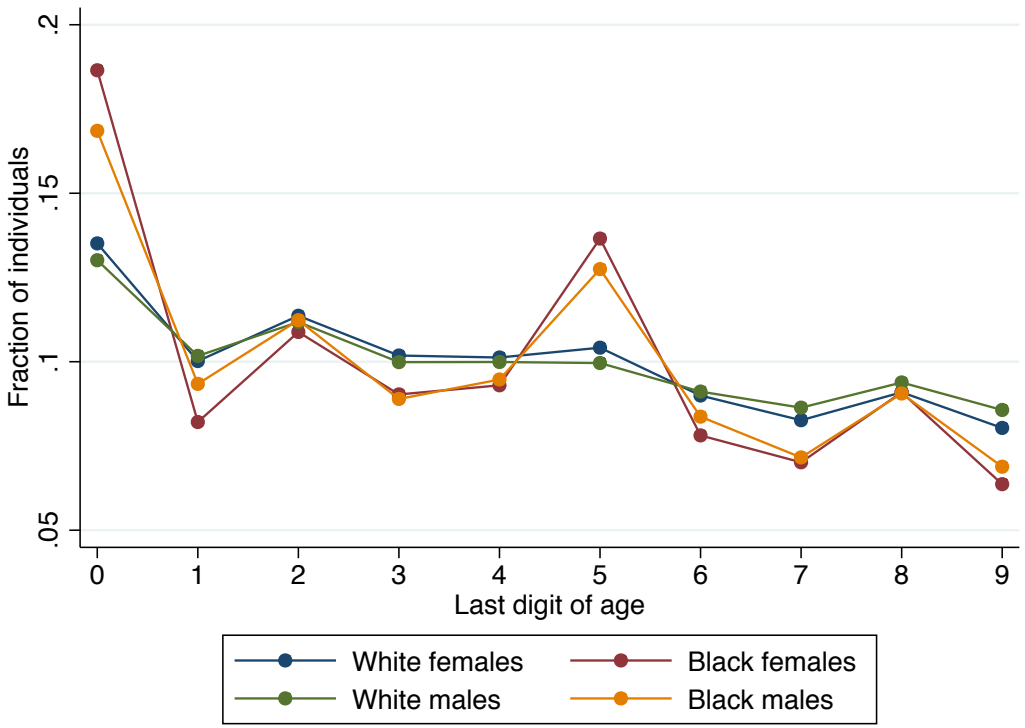
Age heaping over time

Location	Date	Type	Group	% reporting an age ending in 0 or 5
Rome	Roman empire	urban	rich	58.4
Roman Africa	Roman empire	both	rich	61.6
Carthage	Roman empire	urban	rich	50.4
England	1350	both	rich	68.8
Florence, Italy	1427	urban	all	45.6
Pistoia, Italy	1427	urban	all	53.6
Forentine territory	1427	rural	all	62.4
Corfe Castle, England	1790	urban	all	26.4
Corfe Castle, England	1795	urban	poor	31.2
Adleigh, England	1796	rural	all	44
Terling, England	1801	rural	poor	35.2
Cotton operative, England	1833	both	workers	24.8

Issues with Age Heaping

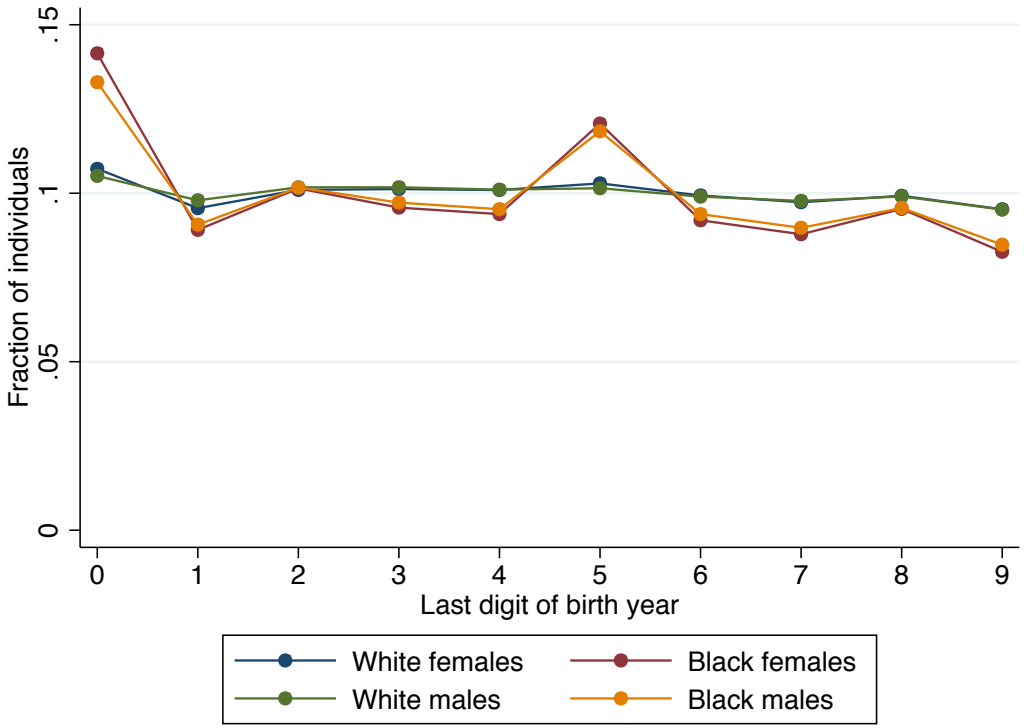
- Big advantage of age heaping is that we only need to observe a cross-section of ages, we don't need multiple observations per person
- Not (at all) a perfect proxy for literacy or education
- All sorts of reasons to misreport age (may want to seem younger, may want to seem older, etc.)
- People may not care about age or reporting it accurately
- Person recording age might not care about recording it accurately

Issues with Age Heaping



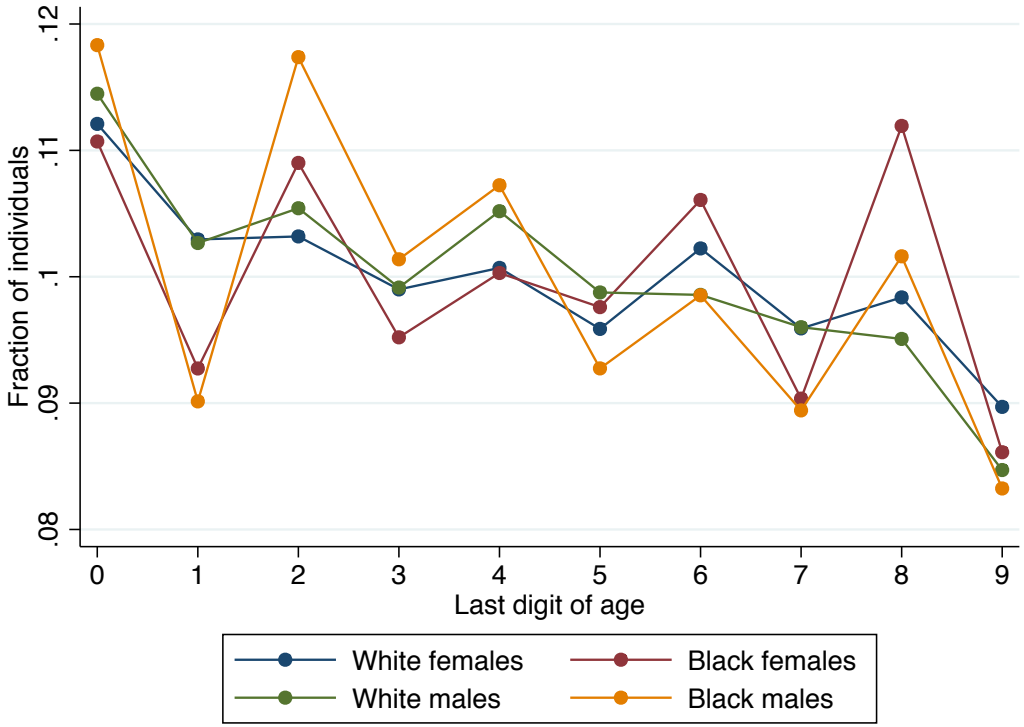
Age heaping in the 1880-1930 federal censuses, North Carolinians over the age of 19

Issues with Age Heaping



Age heaping in North Carolina death certificates 1909-1975, individuals over the age of 19

Issues with Age Heaping



Age heaping in the 1880-1930 federal censuses, North Carolinians between 10 and 19

Issues with Age Heaping: An Aside

- Another interesting issue with age heaping is what people round to
- We like zeros and fives, but that's in part because we use a base ten system
- Think about some other types of rounding:
  - Rounding distance to the quarter mile
  - Recipe amounts rounded to quarters and eighths
  - Han Chinese heap on 12-year cycle related to preferred animal years of the Chinese calendar (year of the dragon is particularly popular)
  - Turkic Muslims in China heap on 0 or 5
- This is a place where econ history adds to economics

Measuring Literacy Rates

- Can look at volume of records as an indication of overall literacy rates (Clark compares England and India on this basis)
- Can look at the number of people that can sign or read various types of documents:
  - Percentage of grooms who signed the marriage register
  - Percentage of witnesses who signed their depositions
  - Percentage of witnesses who signed ecclesiastical court declarations
  - Number of people who could read a passage of the Bible (to get out of secular court)

Measuring Literacy Rates: A US Tangent

SECTION 260: The income arising from the sixteenth section trust fund, the surplus revenue fund, until it is called for by the United States government, and the funds enumerated in sections 257 and 258 of this Constitution, together with a special annual tax of thirty cents on each one hundred dollars of taxable property in this state, ...

Measuring Literacy Rates: A US Tangent

...which the legislature shall levy, shall be applied to the support and maintenance of the public schools, and it shall be the duty of the legislature to increase the public school fund from time to time as the necessity therefor and the condition of the treasury and the resources of the state may justify; ...

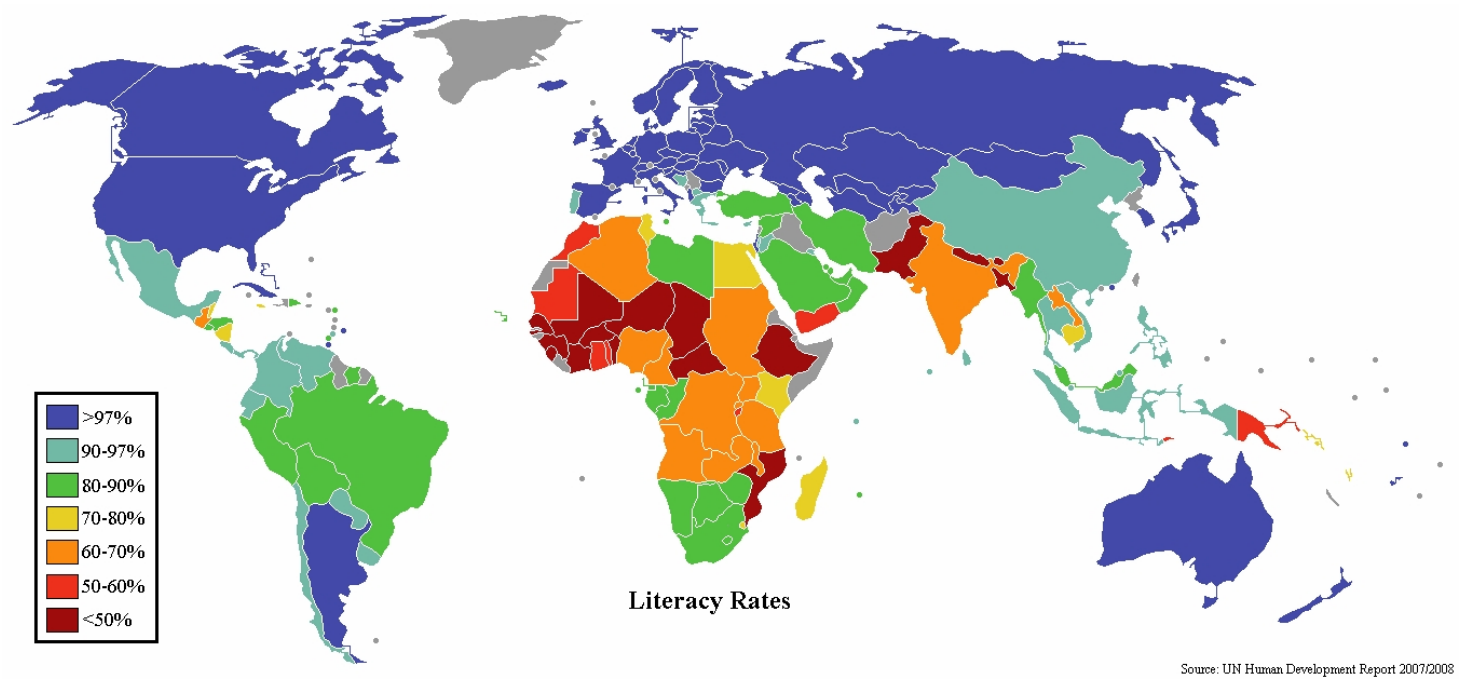
Measuring Literacy Rates: A US Tangent

...provided, that nothing herein contained shall be so construed as to authorize the legislature to levy in any one year a greater rate of state taxation for all purposes, including schools, than sixty-five cents on each one hundred dollars' worth of taxable property; and provided further, that nothing herein contained shall prevent the legislature from first providing for the payment of the bonded indebtedness of the state and interest thereon out of all the revenue of the state.

Measuring Literacy Rates: A US Tangent

SECTION 20: That no person shall be imprisoned for debt.

Literacy Now



Human Capital

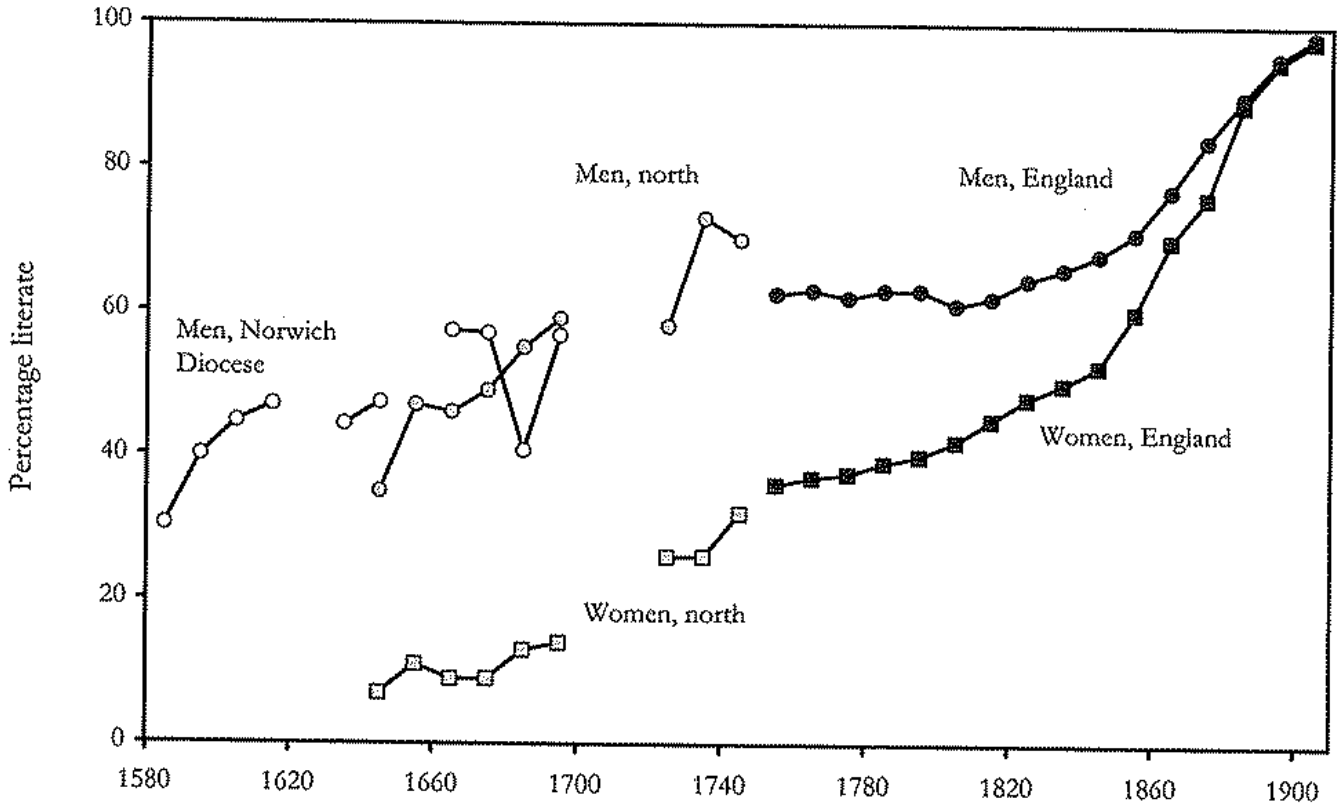


Figure 9.3 Literacy in England, 1580–1920. Data for 1750s–1920s from Schofield, 1973, men and women who sign marriage resisters; for the north, 1630s–1740s, from Houston, 1982, witnesses who sign court depositions; for Norwich Diocese, 1580s–1690s, from Cressy, 1980, witnesses who sign ecclesiastical court declarations.

Human Capital