THE OHIO STATE UNIVERSITY
CHASE CENTER FOR CIVICS, CULTURE, AND SOCIETY

Don't Fear the Reaper

Long Run Economic Growth and the Dynamics of the Malthusian World

Jacob R. Hall[1]

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[1]The Ohio State University

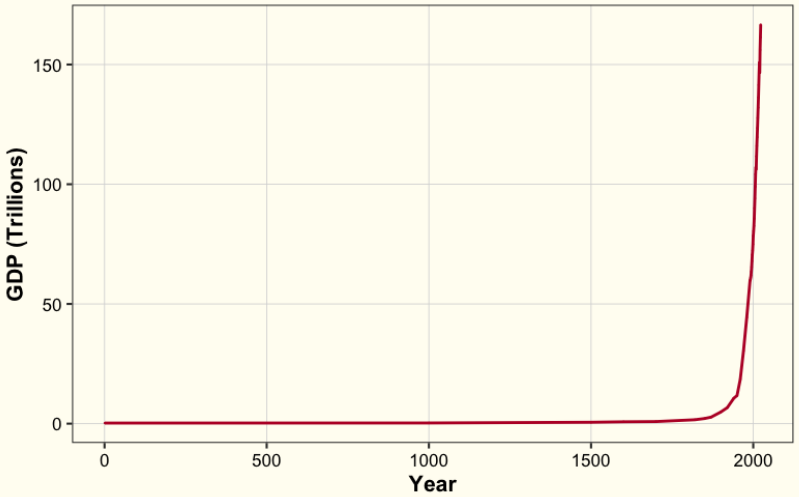
"I am still inclined to think that there was no sizeable difference in the levels of income of the different civilizations when they reached their pre-industrial peak: Rome in the first century, the Arab Caliphates in the tenth, China in the eleventh, India in the seventeenth and Europe at the beginning of the eighteenth."

Paul Bairoch, *Economics and World History: Myths and Paradoxes*, p. 106

Facts about Growth in the Long Run

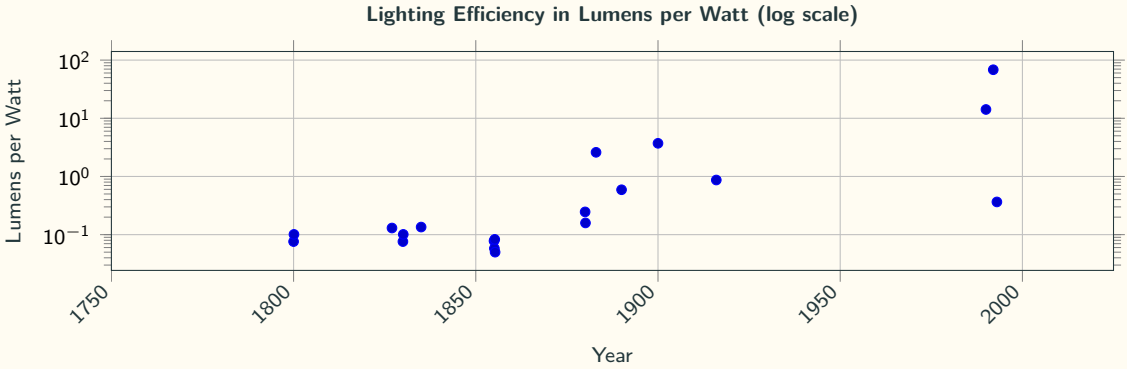
- For most of human history, income per capita growth was glacially slow.
- Before 1500, there was little or no economic growth.
- Angus Maddison, The World Economy: A Millennial Perspective calculates 1500-1820 growth rates:
  1. World GDP per capita: 0.05%.
  2. Europe GDP per capita: 0.14%.
- Around 1800, the average world income was roughly as high as in the Neolithic.
  1. Income was higher in England or the Netherlands.
  2. But it was lower in China or India.
- After 1820: great divergence in income per capita.

The Great Enrichment



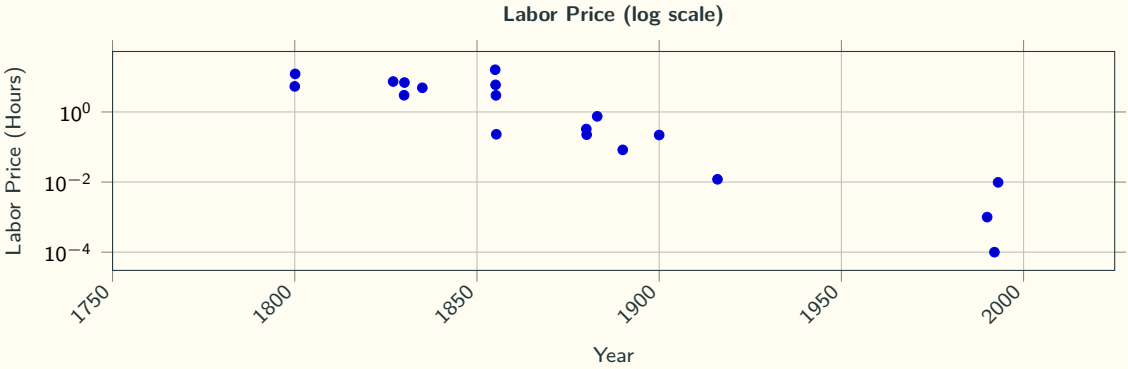
Source: Maddison Project Database 2023

Quality changes and the efficiency of light sources over time



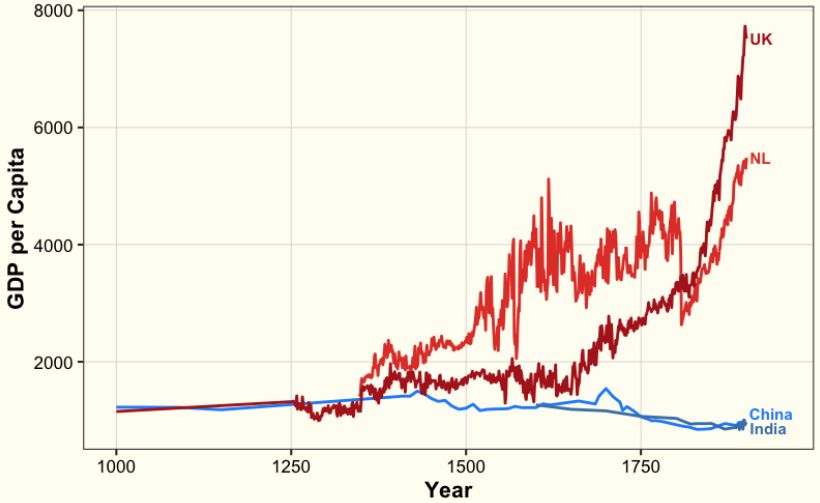
Source: Nordhaus (1997).

The price of light over time



Source: Nordhaus (1997). Note: Labor price is the hours of work per 1,000 lumen hours.

The Great Divergence



Source: Maddison Project Database 2023

"In the flourishing age of the world, it may be expected, that the human species should possess greater vigour both of mind and body, more prosperous health, higher spirits, longer life, and a stronger inclination and power of generation. ... [But] [s]tature and force of body, length of life, even courage and extent of genius, seem hitherto to have been naturally, in all ages, pretty much the same."

David Hume, *Of the Populousness of Ancient Nations*, 1742.

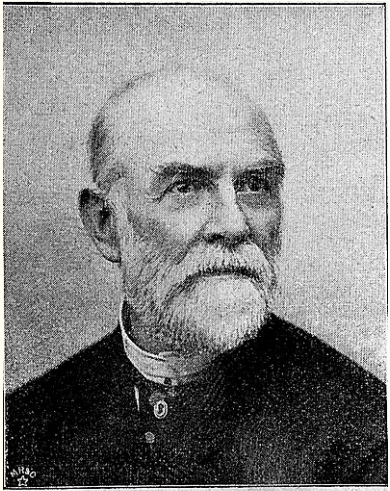
Laborers' Wages

Location	Period	Day wage (pounds of wheat)
Ancient Babylonia	1800–1600 BC	15
Assyria	1500–1350 BC	10
Neo-Babylonia	900–400 BC	9
Classical Athens	408 BC	30
	328 BC	24
Roman Egypt	c. AD 250	8
England	1780–1800	13
	1780–1800	11

Source: Clark (2005)

Engel's Law

- The poorer a family, the larger the share of its income that is spent on food.
- A further specification: As income increases, larger shares of food consumption are devoted to more expensive calories.



Ernſt Engel.

Expenditure Shares of English Laborers before 1800

Category of expenditure	Share (%)
Food and drink	75
Grains and starches	44
Dairy	10
Meat	9
Drink	8
Sugar and honey	3
Salt and pepper	1
Clothing and bedding	10
Housing	6
Heating	5
Light and soap	4

Source: Clark (2005)

Share of Different Products in Food Consumption of Farm Workers

Location	Period	Cereals and pulses (%)	Sugar (%)	Animal products, fats (%)	Alcohol (%)
England	1250–99	48.0	0.0	40.2	11.8
	1300–49	39.7	0.0	43.0	17.0
	1350–99	20.8	0.0	55.3	24.0
	1400–49	18.3	0.0	46.4	34.3
England	1787–96	60.6	4.7	28.4	1.3
Japan	ca. 1750	95.4	0.0	4.6	0.0
India	1950	83.3	1.6	5.4	0.8

Source: Clark (2005)

Height derived from skeletal remains

Time Period	Location	Height (cm)
Mesolithic	Europe	168
Neolithic	Europe	167
	Denmark	173
1600–1800	Holland	167
1700–1800	Norway	165
1700–1850	London	170
Pre-Dynastic	Egypt	165
Dynastic	Egypt	166
2500 BC	Turkey	166
1700 BC	Greece	166
2000–1000 BC	Harappa, India	169
300 BC – AD 250	Japan	161
1200–1600	Japan	159
1603–1837	Japan	158
1450	Marianas, Taumako	174
1650	Easter Island	173
1500–1750	New Zealand	174
1400–1800	Hawaii	173

Source: Clark (2005)

More (adult) heights

Time Period	Location	Type	Height (cm)
1830s	Sweden	Soldiers	172
1710-59	England	Convicts	171
		Indentured servants	171
1830s	England	Soldiers	169
	Northern Italy	Soldiers	167
	Bavaria	Soldiers	167
	France	Soldiers	167
	Netherlands	Soldiers	167
1770–1815	England	Convicts	166
1830s	Hungary	Soldiers	166
	Austria	Soldiers	164
1819–39	W. Africa	Slaves	167
	Mozambique	Slaves	165
	W. Africa (Igbo)	Slaves	163
1800–29	Southern China	Convicts	164
1843	Southern India	Indentured servants	161
1842–44	Northern India	Indentured servants	161
1883–92	Japan	Soldiers	159

Source: Clark (2005)

Heights of modern (adult) hunter-gatherer groups

Period	Group	Location	Height (cm)
1892	Plains Indians	United States	172
1970s	Anbarra	Australia	172
1970s	Rembarranga	Australia	171
1910	Alaskan Inuit	United States	170
1890	Northern Pacific Indians	United States	167
1944	Sandawe	Tanzania	167
1891	Shoshona	United States	166
1970s	Fox Basin Inuit	Canada	166
1880s	Solomon Islanders	Solomon Is.	165
1906	Canadian Inuit	Canada	164
1969	!Kung	Botswana	163
1980s	Ache	Paraguay	163
1970s	Hadza	Tanzania	163
1985	Hiwi	Venezuela	156
1980s	Batak	Philippines	155
1980s	Agta	Philippines	155
1980s	Aka	Central African Rep.	155

Source: Clark (2005)

Life Expectancy and Mortality — Western Europe

Location and Period	e_0	e_{20}	Infant Mort. (%)	Deaths 0–15 (%)
Italy (medieval Pistoia)	29	25	21	56
England, 1550–99	38	33	18	30
England, 1650–99	35	31	18	32
France, 1750–89	28	–	21	–
England, 1750–99	38	34	17	30
London, 1750-99	23	–	30	–

Source: Clark (2005)

Life Expectancy and Mortality — East Asia and Africa

Location and Period	e_0	e_{20}	Infant Mort. (%)	Deaths 0–15 (%)
Egypt (rural), 11–257	28	21	–	45
Egypt (urban), 11–257	24	17	–	48
China (Anhui), 1300–1880	28	33	–	–
China (Beijing), 1644–1739	26	30	–	–
China (Liaoning), 1792–1867	26	35	–	–
Rural Japan, 1776–1815	33	37	25	50

Source: Clark (2005)

Life Expectancy at Age 20

Group	Period	Type	LE at 20
Italy (Canusium)	AD 223	Magistrates	33
Italy	ca. AD 200	Ex-slaves	28
England	1300–1348	Tenants	28
England	1350–1400	Tenants	32
England	1440–1540	Monks	27
England	1600–1638	Testators	35
England	1750–1799	General	34
Rural Japan	1776–1815	General	37
Rural China (Liaoning)	1792–1867	General	35
Modern foragers	–	Foragers	40

Source: Clark (2005)

Life Expectancy and Mortality of Modern Foragers

Group	e_0	e_{20}	Infant Mort. (%)	Deaths 0–15 (%)
Ache, Paraguay	37	37	12	34
Kutchin, Yukon	35	–	17	35
Hadza, Tanzania	33	39	21	46
!Kung, Ngamiland, Botswana	32	–	12	42
!Kung, Dobe, Botswana	30	40	26	44
Agta, Philippines	24	47	37	49

Source: Clark (2005)

World Income and Population

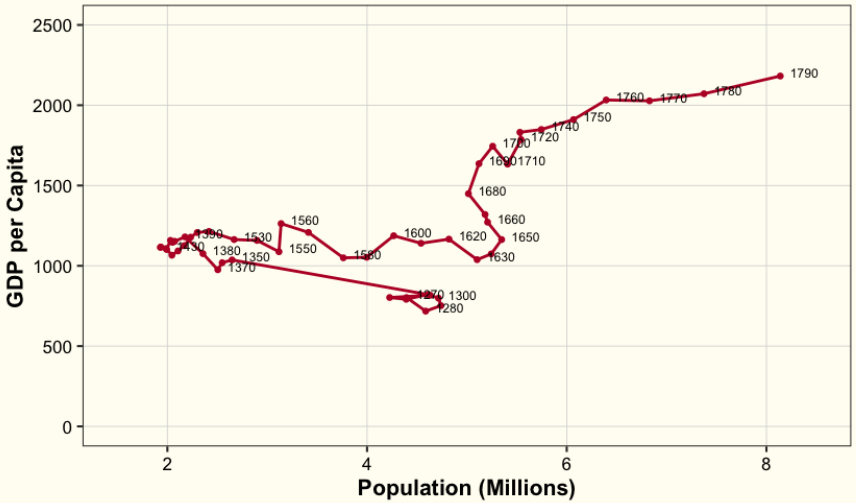
- Before the 1800s, the world is in the Malthusian trap: improvements in technology only translate in increases in world population.
- In the 1800s the western world moved away from the trap: *demographic transition*.
- In the 1900s, much of the rest of the world went through similar process.
- Countries in Africa and the Middle East still lag.
- We want to understand the Malthusian trap and the demographic transition.

Population and Income per Capita

Year	Population (millions)	GDP per capita ($)
-5000	5	205
-1000	50	240
1	170	210
1000	265	250
1500	425	260
1800	900	375
1900	1,625	1,275
1950	2,515	3,050
2000	6,120	12,262
2015	7,300	15,000

Source: Maddison Project Database (2020)

Population and Income per Capita in England



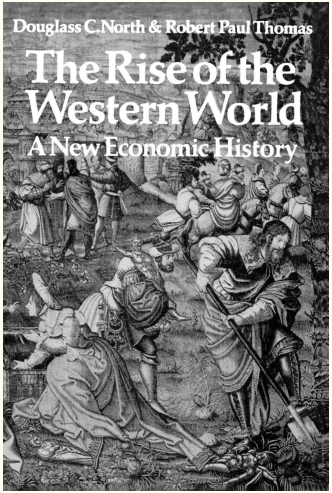
Source: Bank of England; processed by *Our World in Data*

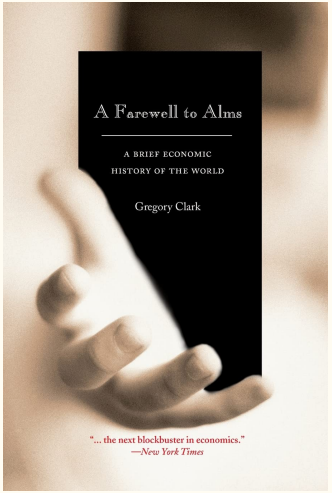
A Malthusian model

- Thomas R. Malthus, An Essay on the Principle of Population, 1798.
- Simple yet powerful model of the relation between population and economic growth.
  - Good description of the evidence of humanity until around 1800.
  - Good description of the natural economy of animals.

A note on models

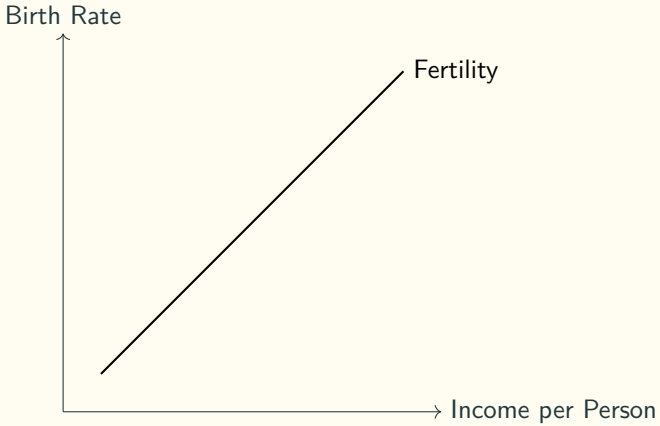
- Models are simplified representations of the world - just like a map.
- It is better if we make our models explicit.
- All models have assumptions. The important question is *what* are we going to assume.
- All models are wrong, but some are useful.
- Don't think of the model as needing to describe or explain *everything*.


Douglass C. North & Robert Paul Thomas
The Rise of the Western World
A New Economic History


A Farewell to Alms
A BRIEF ECONOMIC HISTORY OF THE WORLD
Gregory Clark
"... the next blockbuster in economics."
—New York Times

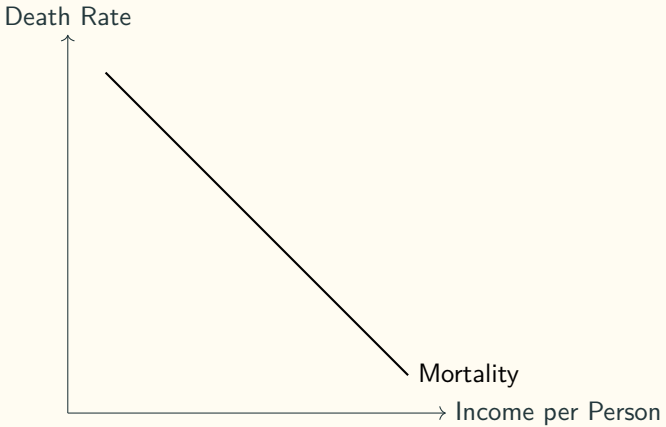
Assumption 1

The birth rate of society is increasing or constant in material living standards.



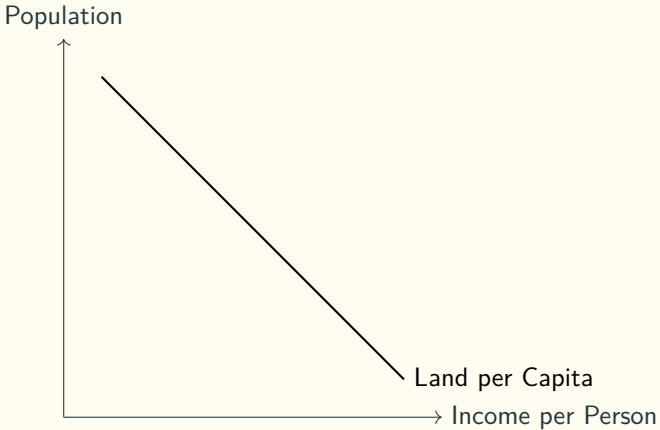
Assumption 2

The death rate of society is decreasing in material living standards.



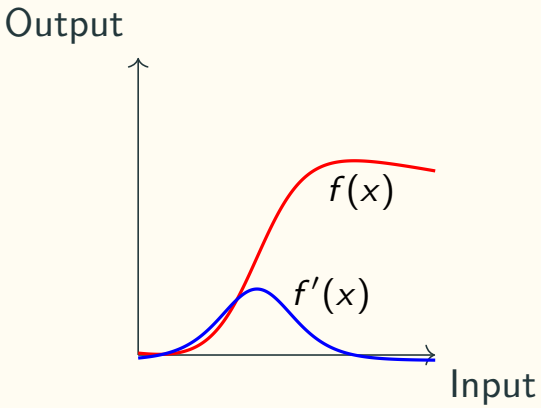
Assumption 3

Material livings standards decline as population increases.



The Law of Diminishing Marginal Returns

- Imagine production with two factors: one fixed, one variable.
- **As more units of the variable factor are added to the fixed factor, the marginal returns to the additional units will, beyond some amount, begin to decrease.**
- In the Malthusian model:
  - Fixed factor: **land**
  - Variable factor: **labor**

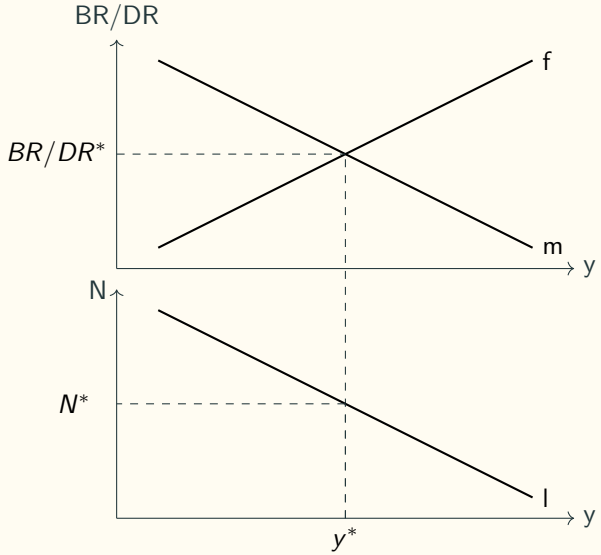


The Crux of the Matter

[In the premodern world,] private benefits were high in bearing children, not only as a source of labor from a very early age, but as a source of social security in the extended family system that prevailed, whereby the able-bodied took care of the young and the aged. These gains outweighed the private costs (in terms of time and resource consumption) of rearing children. In short, when children were an asset, fertility rates tended to be very high, and in a world of abundant land, private and social benefits and costs were approximately equal. But as soon as all the good land was taken up and diminishing returns set in, private versus social costs and benefits suffered a sharp divergence.

Douglass North and Robert Thomas, *The Rise of the Western World*, p. 21

Basic Malthusian Model

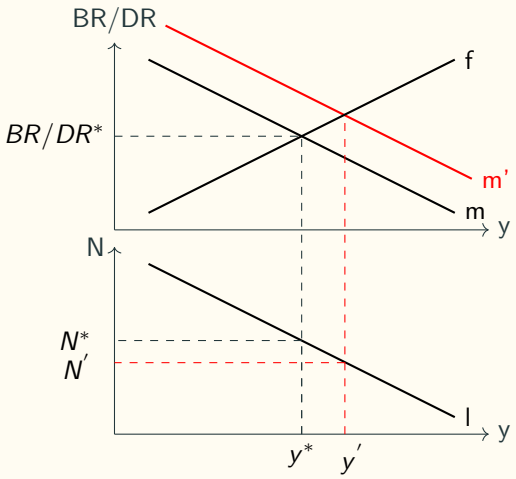


Steady-state Equilibrium and Comparative Statics

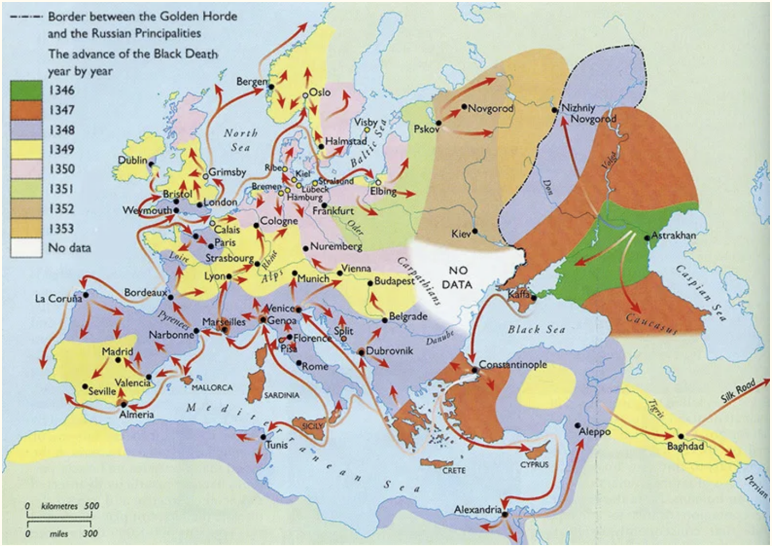
- The equilibrium income per person is "stable".
- We can call the equilibrium income per person the "subsistence income".
  - That does not mean people are subsisting nutritionally and barely surviving, but that the level of income equates the birth rate and the death rate.
- You can conceptualize comparative statics as a shock to a single region or as a comparison between two regions.

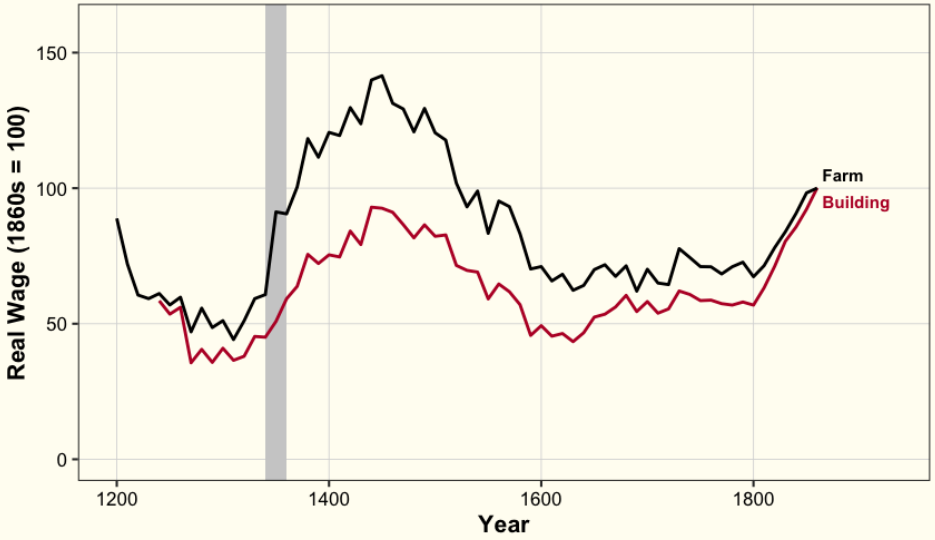
Comparative Statics 1

- Suppose that, in a region governed by Malthusian forces, there is an **exogenous increase** in the mortality rate.
- There is an increase in the mortality schedule.
- From our previous analysis:
  1. Population density will be lower in period 2 compared to period 1.
  2. Income per capita will be higher in period 2 compared to period 1.



A Historical Example





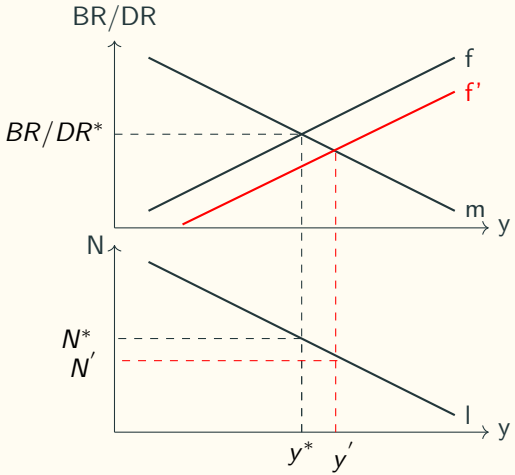
Source: Clark (2005)

A Slightly Different Historical Example

- In 1609, the Spanish Crown suddenly expelled Spain's roughly its 300,000 Morisco (converted muslims) population.
  - The Kingdom of Valencia lost 130,000 Moriscos or roughly one-third of its pre-expulsion population.
- As predicted, districts with previously high levels of moriscos experienced:
  1. a decline in population
  2. an increase in output per capita

Comparative Statics 2

- Suppose that in a Malthusian world, we have two regions, the first one where women marry early and one where women marry late.
- Thus, the second region has a lower fertility schedule.
- From our previous analysis:
  1. Income per capita will be higher in the first region.
  2. Population density will be lower.



The Preventative Check

In almost all the more improved countries of modern Europe, the principal check which keeps the population down to the level of of the actual means of subsistence is the prudential restraint on marriage.

Thomas R. Malthus, *A Summary View of the Principle of Population, 1830*, p. 254

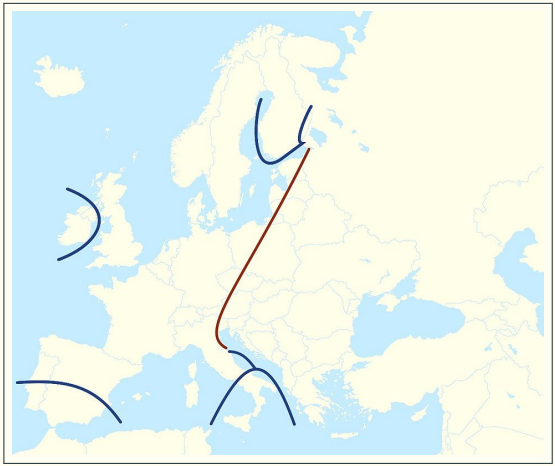
Historical Example

Period	Region	Avg. Age at First Marriage	Cumulative Marital Fertility
Roman Empire	–	12–15	–
ca. 500 AD	Western Europe	18–19	–
12th	England (nobles)	17	–
17th century	England	25.0	7.6
17th century	France	24.6	9.0
17th century	Belgium	25.0	8.9
17th century	Germany	26.4	8.1
17th century	Scandinavia	26.7	8.3
17th century	Switzerland	–	9.3

Source: Clark (2005). *Note:* Cumulative marital fertility = number of live births per married woman aged 20 to 44.

A Historical Example

- The Hajnal line between Saint Petersburg to Trieste.
- Western European Marriage pattern:
  1. High marriage age of women (around 24-26 y.o)
  2. Around 10-25% of women remained celibate
  3. Low illegitimacy rates (around 3-4% of births)
  4. Appears in the later middle ages, and strongest in Northwestern Europe



Malthusian Population Checks

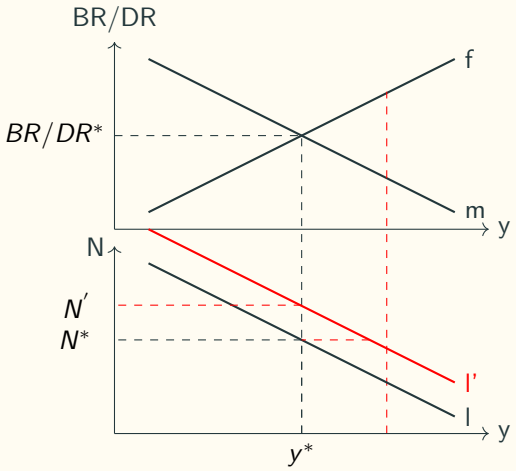
- The ultimate check on population growth is limited food supply, but there are others.

Positive Checks *(Increasing Deaths)*	**Preventive Checks** *(Reducing Births)*
War	Moral restraint
Famine	Contraception
Pestilence	Abortion

Source: Ekelund Jr. and Hébert (1975)

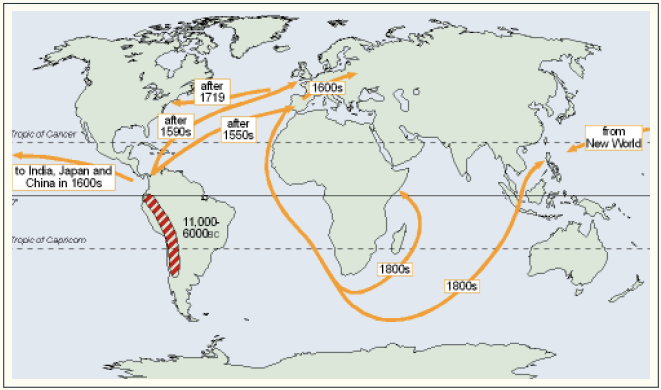
Comparative Statics 3

- Suppose that, in a region governed by Malthusian forces, there is an **exogenous increase in productivity**.
- From our previous analysis:
  1. Income per capita will be the same in period 2 as it was in period 1.
  2. Population density will be higher in period 2.



A Historical Example

- Archeological evidence suggests that the potato was first cultivated in the Andes between 7000 and 10,000 years ago.
- Potato discovered by Europeans with their discovery of the Americas, and brought back to the Old World.
- Although widespread cultivation did not begin until the late 17th and early 18th centuries.



The Superiority of the Potato

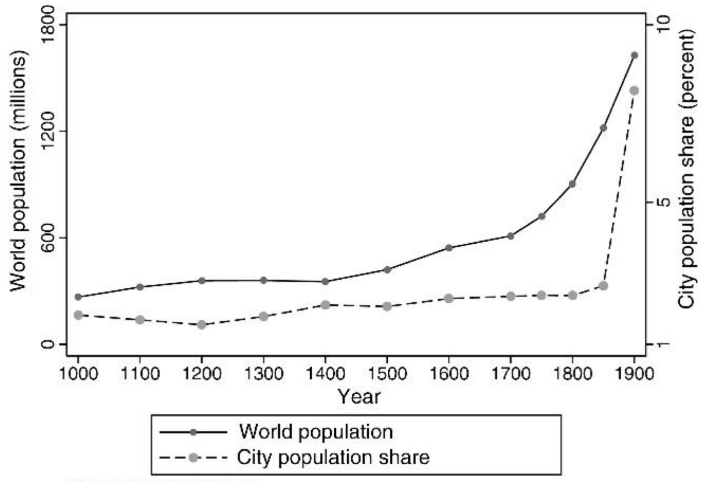
	Average yield per acre		Energy value of crop	Acres of land needed to provide 42 MJ/day for one year
	Bushels	*Kilograms*	*megajoules*	
Wheat	23	650	8,900	1.7
Barley	32	820	11,400	1.4
Oats	38	690	9,300	1.6
Potatoes	427	10,900	31,900	0.5

Nunn and Qian (2011)

Counterfactual

Absent the potato:

- The increase in population would have only been 74% of what it actually was.
- The increase in urbanization would have only been 66% of what it actually was.



Nunn and Qian (2011)

Comparative Statics 4

- Let us suppose that in a Malthusian world, we have two countries, the first with an Emperor that taxes τ of agricultural production to finance his private consumption, for example, a grand palace.
- We have that the after-tax income is then $\tilde{y} = (1 - \tau)y$.
- With this new technology level, the analysis goes through unchanged with respect to the previous case:
  1. Income per capita will be the same in both countries.
  2. Population density will be lower in the first country.

Political Economy Consequences

- Hence, the cost of the palace is less population, not a lower income for the existing population.
- Similarly, having a landed gentry obtaining a huge rent from farmers only implies a lower population, not higher income:
  1. Elites may live much better if productivity increases (and hence taxes), even if the average person does not improve.
  2. Strong limit to the effects of redistribution.
- Contrary to some anthropologists and historians, the origin of the state does **not** require an output (grain) surplus.

Waves of Population

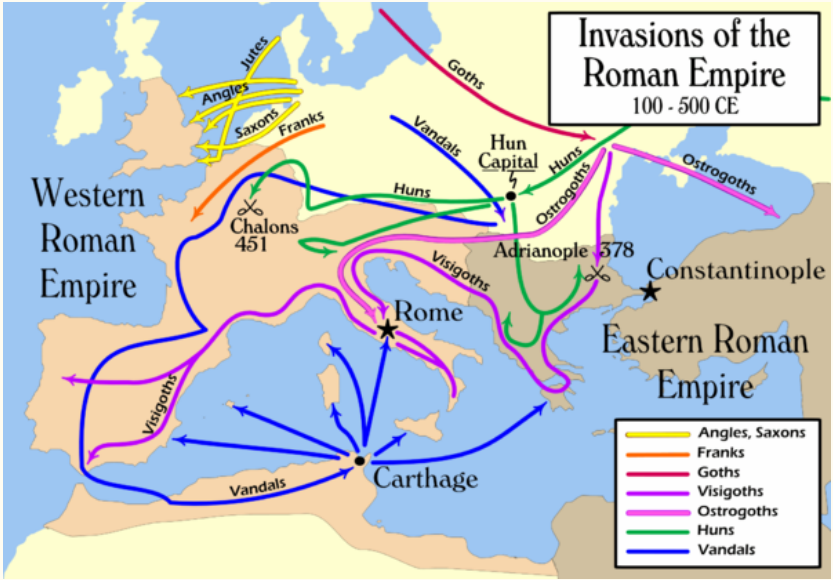
What has changed entirely is the rhythm of the population increase. At present it registers a continuous rise, more or less rapid according to society and economy but always continuous. Previously it rose and then fell like a series of tides. This alternate demographic ebb and flow characterised life in former times, which was a succession of downward and upward movements, the first almost but not completely cancelling out the second. These basic facts make almost everything else seem secondary.

Fernand Braudel, *Civilization and Capitalism, 15th–18th Century: The Structure of Everyday Life*, p. 30

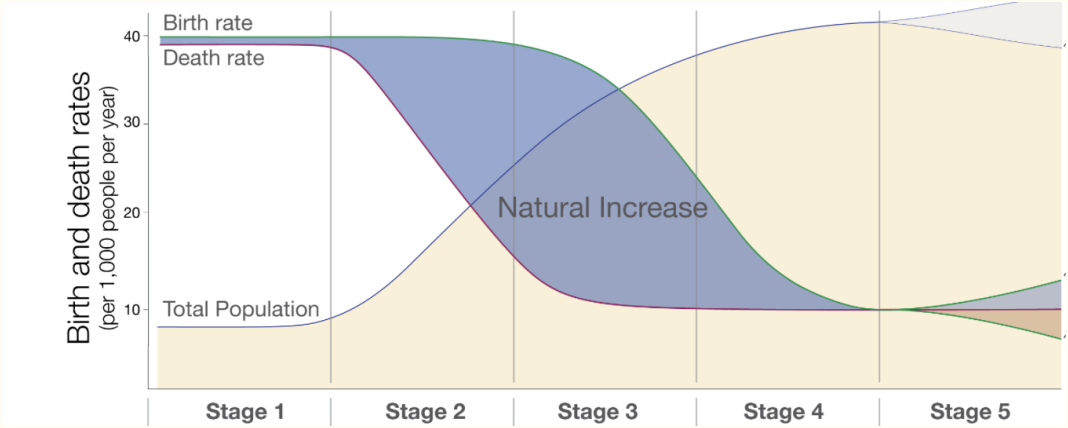
Malthusian Migrations

The dynamic element that gave impetus to growth and development during the high Middle Ages was continued population growth. Even with primitive technology, the relative abundance of land and other natural resources ensured a level of labor productivity above biological subsidence. The tendency for population to grow continued so long as additional virgin land could be brought into cultivation as the need arose, to feed additional mouths. This appears to have been the case in Western Europe until the 13th century. ... Thus by migration they could escape the diminishing returns and falling incomes plaguing the manor of their birth. In this way population growth generated a frontier movement.

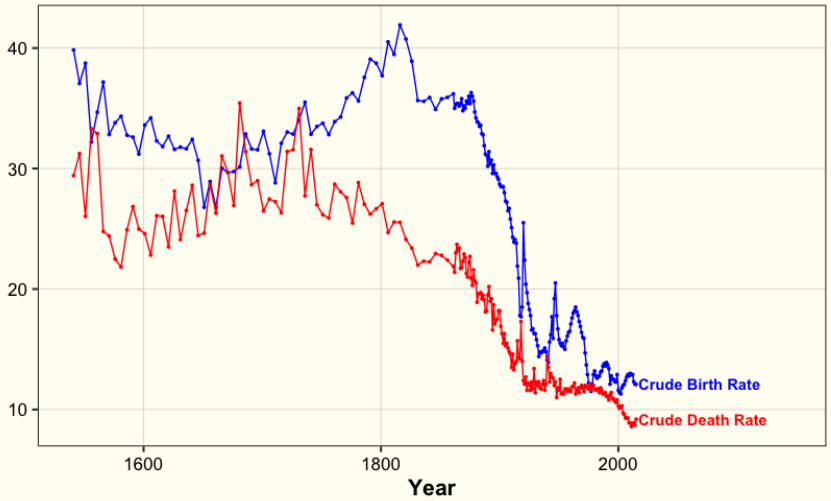
Douglass North and Robert Thomas, *The Rise of the Western World*, p. 35


Invasions of the Roman Empire
100 - 500 CE
Jutes
Angles
Saxons
Franks
Goths
Vandals
Hun Capital
Huns
Ostrogoths
Huns
Ostrogoths
Western Roman Empire
Chalons 451
Adrianople 378
Visigoths
Constantinople
Rome
Eastern Roman Empire
Visigoths
Carthage
Vandals
Angles, Saxons
Franks
Goths
Visigoths
Ostrogoths
Huns
Vandals

The Demographic Transition

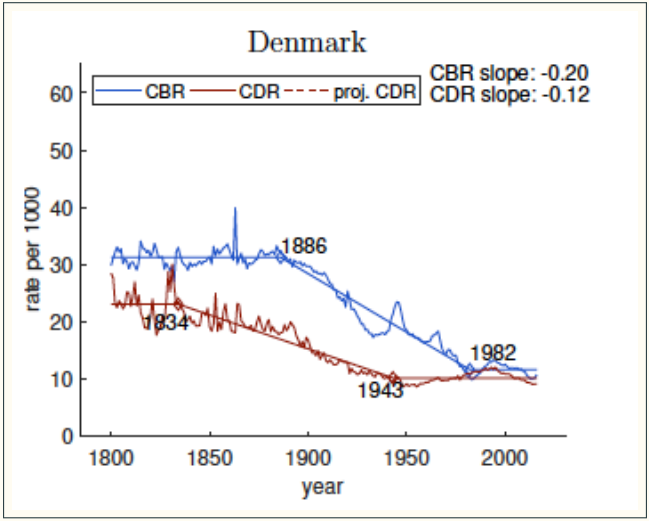


The Demographic Transition: England & Wales



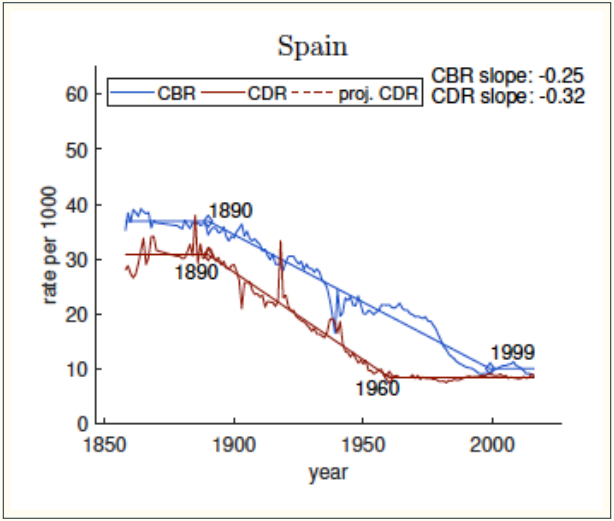
Source: Wrigley and Schofield (1981), Mitchell (2010), and UK ONS (2016)

The Demographic Transition: Denmark



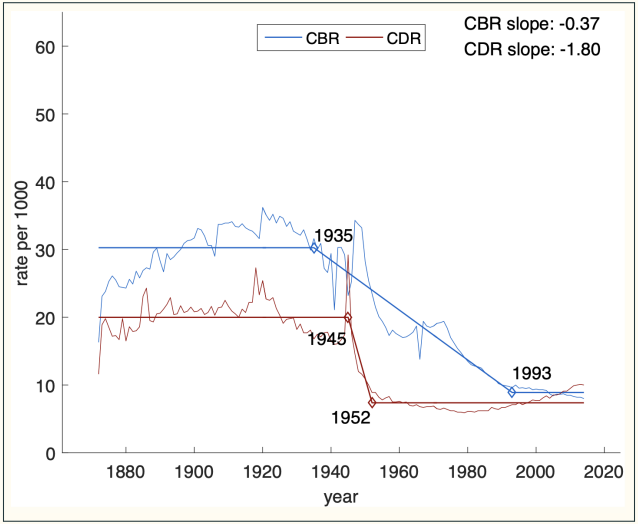
Source: Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021).

The Demographic Transition: Spain



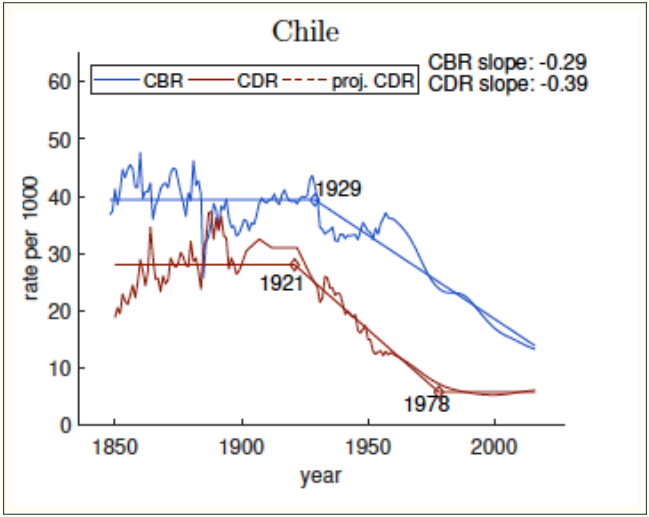
Source: Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021).

The Demographic Transition: Japan



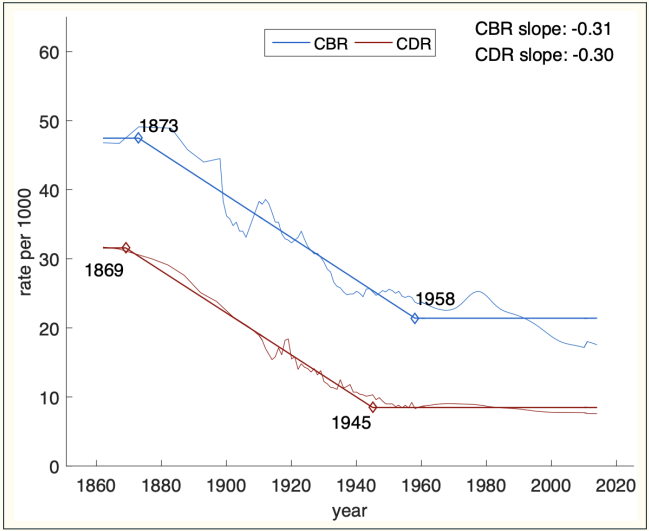
Source: Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021).

The Demographic Transition: Chile



Source: Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021).

The Demographic Transition: Argentina



Source: Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021).

Mechanisms for Change

1. Farming vs. manufacturing/services economy
2. Child labor
3. Survival rates
4. Modern financial markets and social security.
5. **Quantity-quality trade-off**
6. Contraceptive technologies
7. **Cultural norms (including secularization & gender roles)**

The Quantity–Quality Tradeoff

- Parents derive utility from both the **number** of children (n) and their **quality** (q), where quality is can be thought of as spending per child.
- The total cost of children is $C = n \cdot q$.
- Because spending accrues for each child, increasing q makes additional children more expensive.
- Likewise, increasing n raises the total cost of maintaining any given level of q.
- As technological change increases the demand for human capital, parents invest more heavily in the human capital (the quality) of their children ... and thus have fewer of them.

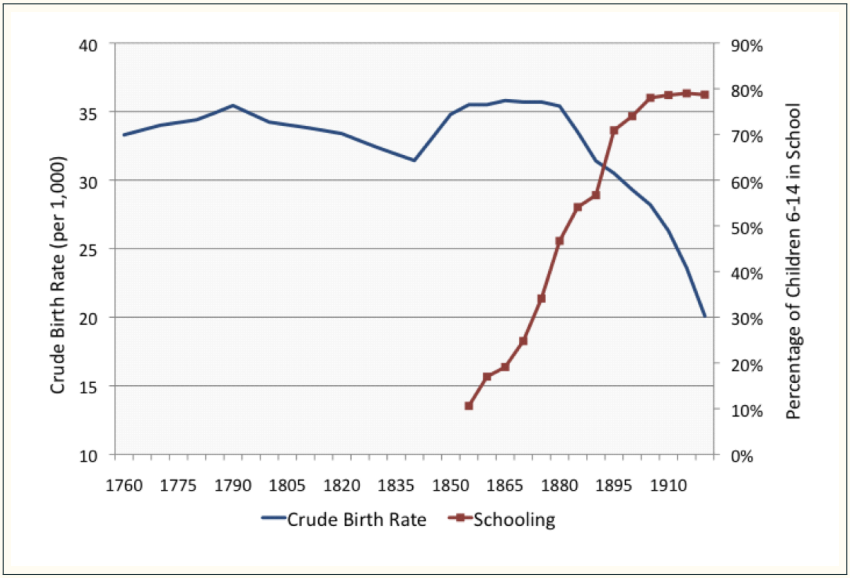


Figure 1: Sources: Wrigley and Schofield (1981); Flora et. al. (1983).

Timing of the decline in fertility rate

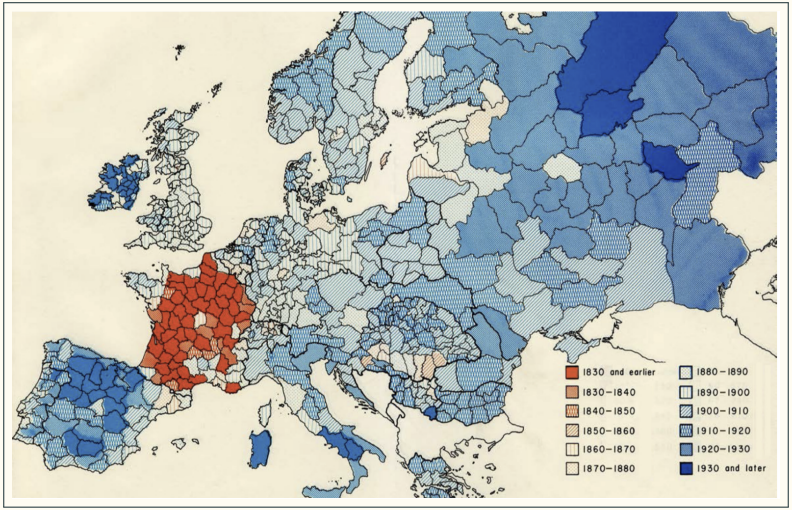
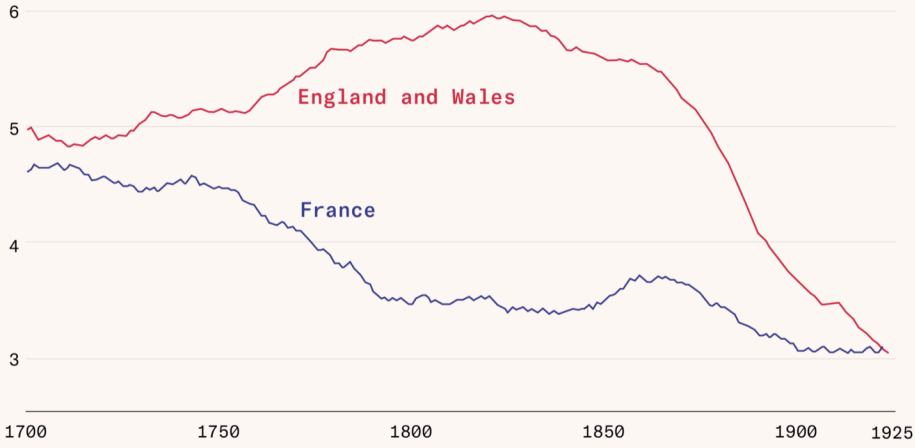


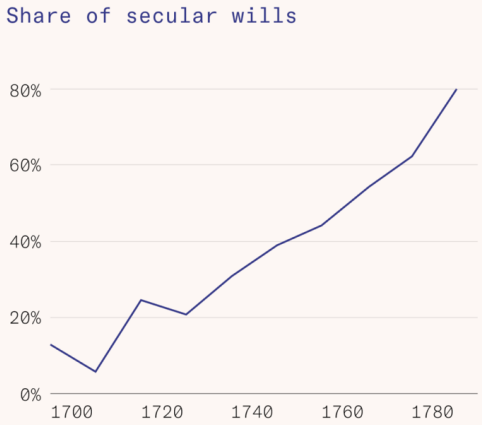
Figure 2: Coale and Watkins (1986)

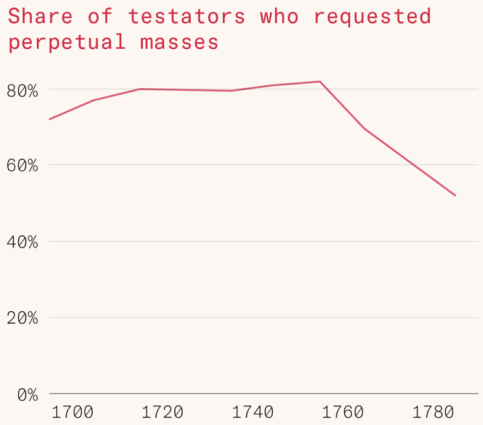
The historical fertility transition, France vs England & Wales



Note: Historical data crowdsourced from publicly available genealogies
Source: Guillaume Blanc (2022)

The loss of influence of the Roman Catholic Church



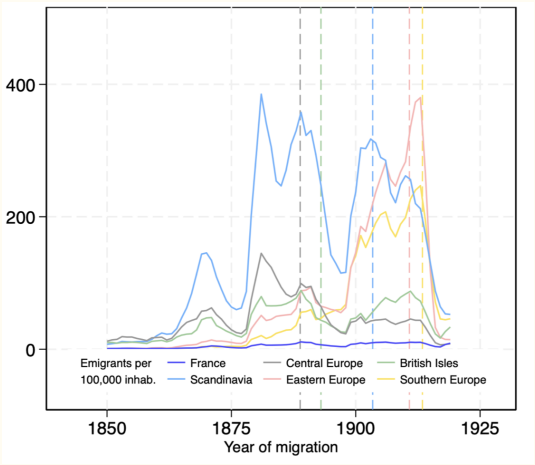


Source: Guillaume Blanc (2022) and Michel Vovelle (1973)

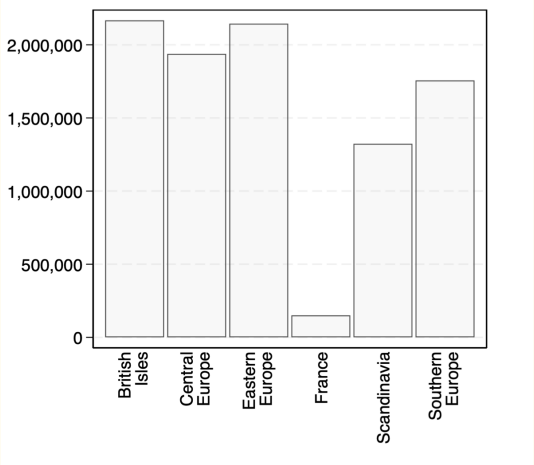
Prior to this, France was destined to take over the New World.

- In 1750, France had a population of 24.5 million, compared to England's 5.5 million.

Emigration flows to the US during the Age of Mass Migration



(a) Per capita, through time



(b) Total, by region

Source: Blanc and Wacziarg (2025)

A Malthusian Migration Counterfactual

- In 1750, France had a population of 24.5 million, compared to England's 5.5 million.
- By 2020, England's population had grown to 56.5 million, while France's only increased to 65.25 million.
- If the French population had grown at the same rate as the English after 1750, France would now have a population of **251.7 million**!
- Blanc and Wacziarg show that this implies a counterfactual French diaspora today of 320.4 million, instead of the actual 26.1 million ... a vast majority of which would have resided in the New World.
- Dans un monde parallèle, je donne cette conférence en français.

Key Takeaways: The Malthusian World

- For most of human history, economic progress translated into **more people**, not higher incomes.
- The Malthusian model captures this world: **birth and death rates respond to living standards**, which in turn respond to population pressure.
- Shocks like famine, war, or plague raised income per capita—but only temporarily. Population growth eventually erased the gains.
- Institutions and policies (e.g., marriage norms, taxation) shaped regional variation in income and population, but not sustained growth.
- Breaking out of the Malthusian trap required a **fundamental change in demographic behavior**—the demographic transition.

THE OHIO STATE UNIVERSITY
CHASE CENTER FOR CIVICS, CULTURE, AND SOCIETY

Don't Fear the Reaper

Long Run Economic Growth and the Dynamics of the Malthusian World

Jacob R. Hall[1]

July 30, 2025

[1]The Ohio State University