Advanced Macroeconomics

Very long run determinants of economic growth and income disparities

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February 10, 2018

Plan of the lecture

1. The UGT
   - The three phases of economic growth
   - The UGT: a simple presentation
   - Refinements of UGT
   - Pre-conditions
2. Beyond UGT: the deep roots of development
   - Some premises: guns, germs and steel
   - The founding contribution of Acemoglu et al.
   - The global view of Galor on comparative development
   - Refinements of Galor's contributions
   - The alternative movement
3. Conclusion

Key data, key question

Economic growth since 1800 (data from Maddison, 2001):

- Evolution of gdp per capita in constant dollars in Belgium between 1820 and 2001:

$$\frac{y_{2001}}{y_{1820}} = \frac{20924}{1319} = 16$$

- Differential between Belgium and Africa as a whole:

$$\frac{y_{1820}^{Belgique}}{y_{1820}^{Afrique}} = \frac{1319}{420} = 3$$

$$\frac{y_{2001}^{Belgique}}{y_{2001}^{Afrique}} = \frac{20924}{1489} = 14$$

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Which data can we use?

It is legitimate to wonder about the quality of data

- World data $\rightarrow$ very long run

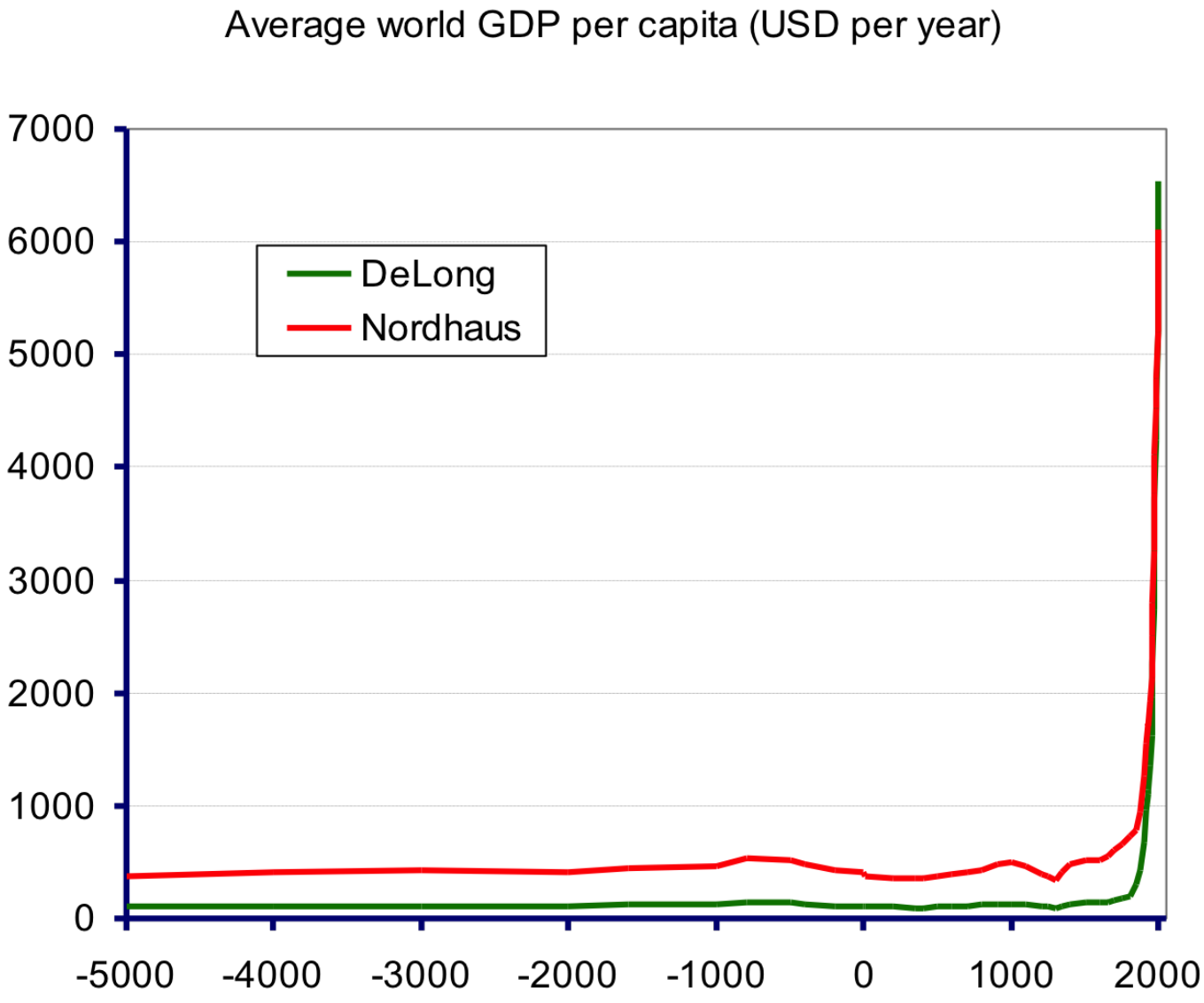
  J. Bradford DeLong, *Estimating World GDP, One Million B.C. - Present*, Department of Economics, U.C. Berkeley
- Country level data

  A. Maddison, *The World Economy - a Millennial Perspective*, OECD
- The specific case of England: 600 years of real wages

  G. Clark, The Long March of History: Farm Laborers' Wages in England 1208-1850, UC Davis

Combining these sources, we have 4 centuries of data for more than 50 countries plus very long estimations for the World

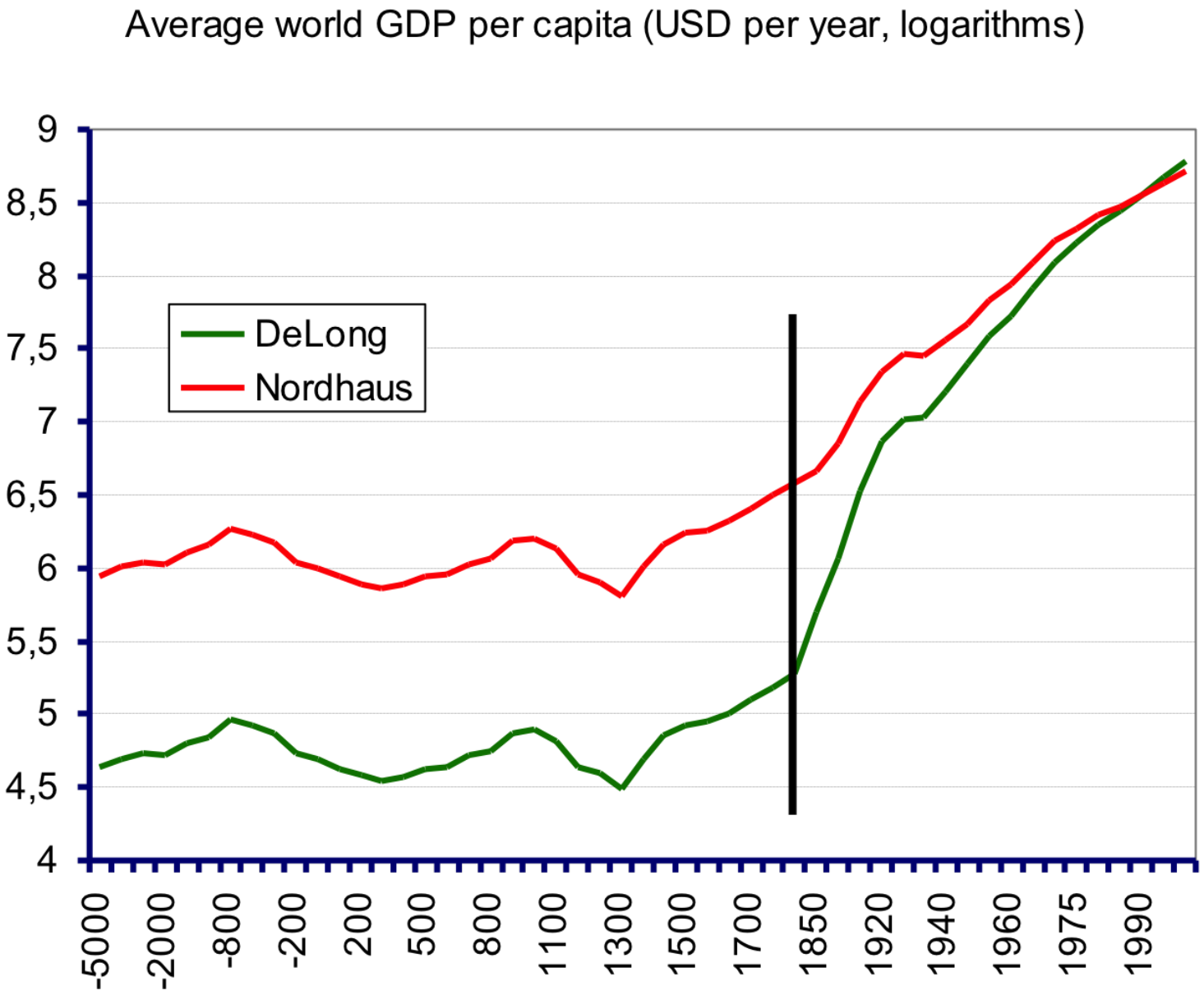
Lond term dynamics of World's income



Evolution de long terme du revenu mondial

- Aggregated data abstracting from inequalities (international and national)
- Difference between Nordhaus and Delong: Delong corrects Nordhaus' data and includes the fact that some goods did not exist before 1800
- Long period of stagnation at the subsistence level and then explosion of income per capita during the last two centuries: in 1800, the average human has a real income amouting for only twice the one of the average human or year 1
- It doesn't mean that technological progress did not exist before 1800: in 1800, the elites (priests, soldiers and administrative elites) enjoyed much higher standards of living compared to their predecessors....
- ... **but** the average human was living close to the subsistence level

Logarithmic vision



An alternative measure of economic growth

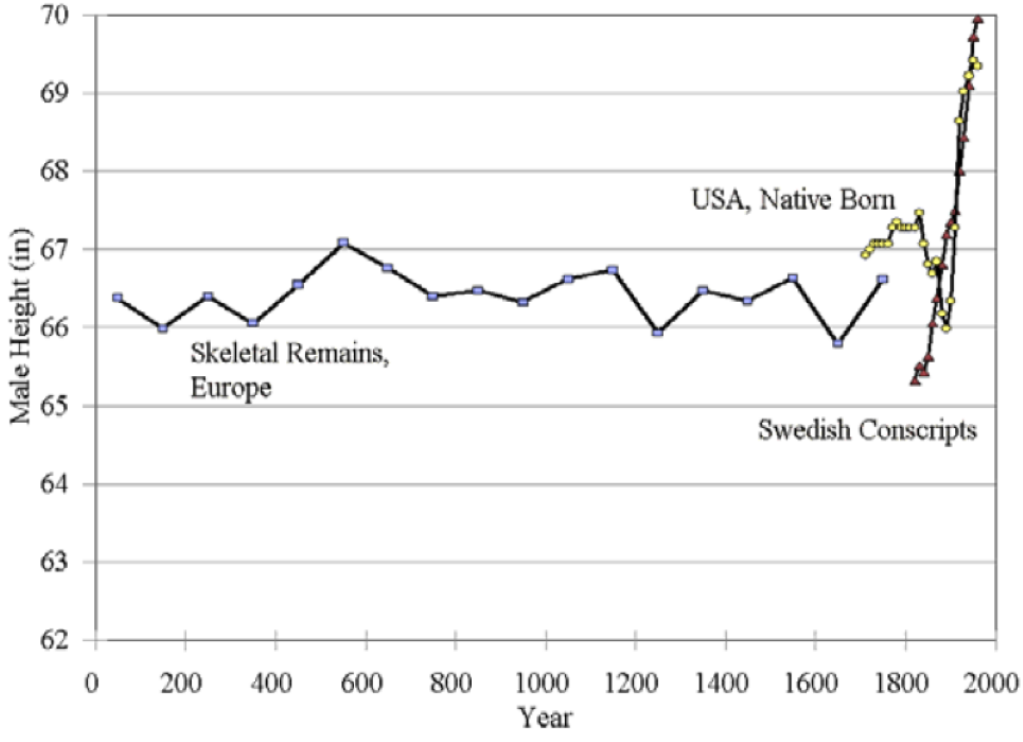


Figure 6 Male heights from skeletons in Europe, 1 AD to 2000[18]

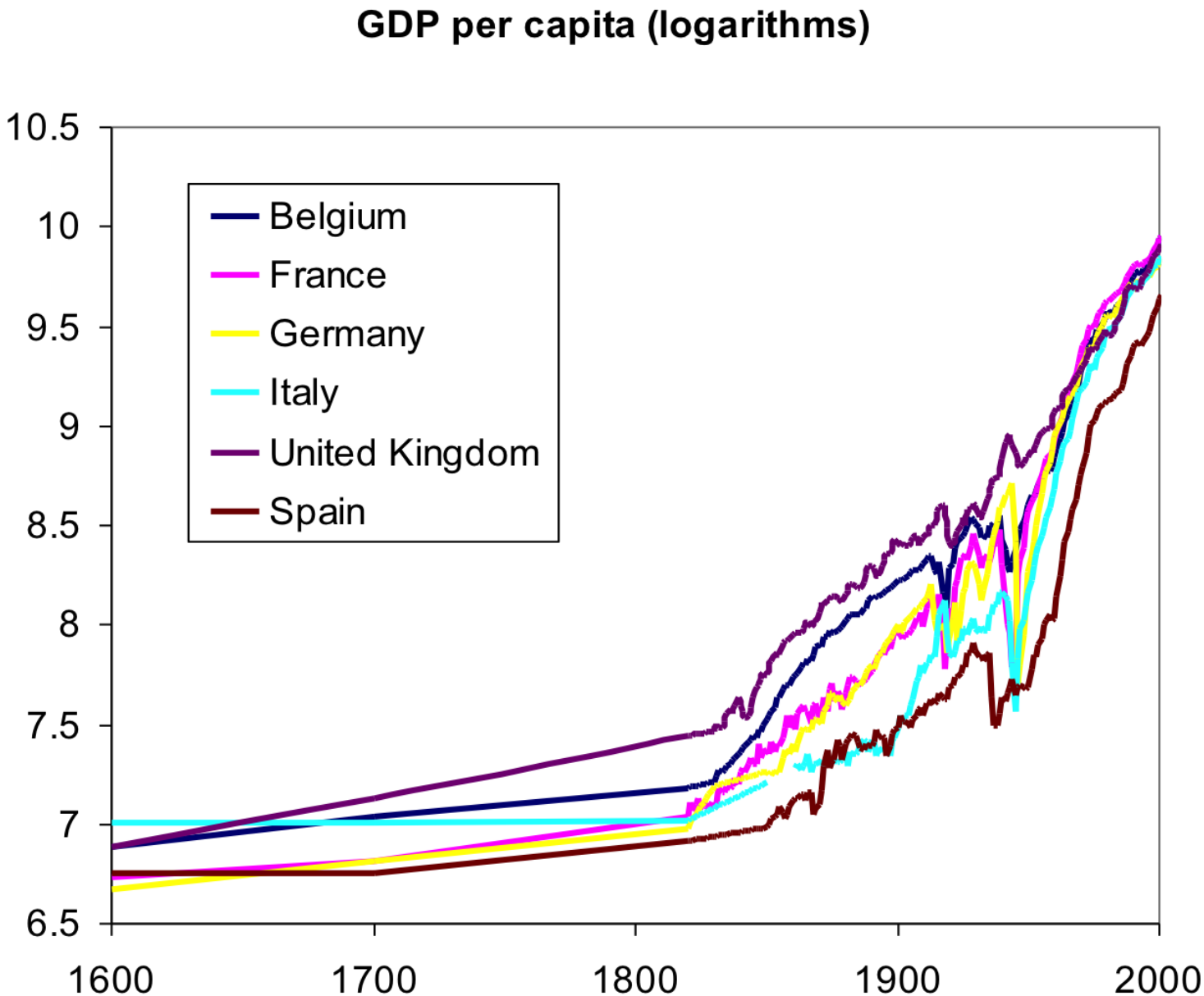
Source: Clark, Farewell To Alms

Disaggregation at the country level

Data from Maddison: estimations from Year 1 et measures from 1820

European countries embraced similar growth patterns what is not the case of many other countries

Disaggregation at the country level



Désagrégation au niveau des pays

- 1600: Italy is the richest country
- 1700-1820: England emerges as a leader and grow faster than other countries, it also urbanizes rapidly
- 1820-: acceleration of economic growth + convergence between European countries
- Important fact: in 1820, China has a higher gdp per capita than any other European country

Decomposition of Western European GDP

- The total GDP of a country equals its population size multiplied by the average gdp per capita:

$$Y_t = y_t \cdot N_t$$

- The growth rate of total gdp may then be expressed as:

$$\frac{Y_{t+1} - Y_t}{Y_t} = \frac{y_{t+1} - y_t}{y_t} + \frac{N_{t+1} - N_t}{N_t}$$

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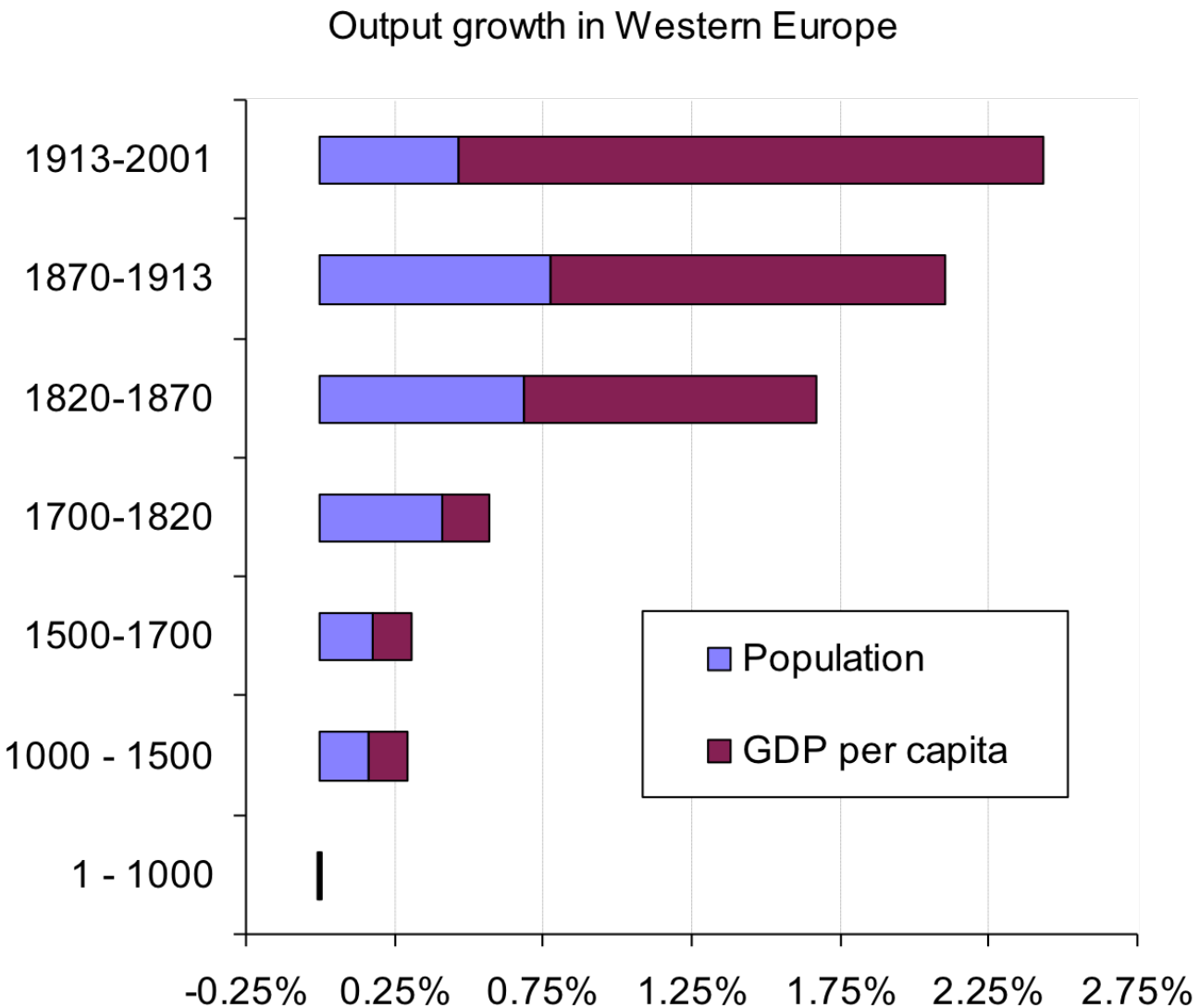

Figure: :

Decomposition of Galor and Weil

1. **Up to 1700: Malthusian stagnation**
   - gdp per capita is constant
   - Population size grows slowly
2. **Post-Malthusian regime**
   - Population growth accelerates as well as the one of income per capita
3. **Modern economic regime**
   - Rapid and sustained growth of gdp per capita
   - Population growth decelerates coming back to Malthusian standards

Decomposition of Galor and Weil: from Malthus to Solow

$\Rightarrow$

Decomposition of Galor and Weil: from Malthus to Solow

- Malthus [1766-1834]: population economist, classical economist
  - Malthusian trap: income increases $\rightarrow$ population size increases $\rightarrow$ decreasing returns of the land $\rightarrow$ shrink in income $\rightarrow$ subsistence
  - Mathus' conclusions:
    - births control is the unique valid policy to increase wealth
    - technological progress translates into larger population
- Solow [1924-]: technoclogical progress allows sustained economic growth

Decomposition of Galor and Weil: from Malthus to Solow

Key question: *How did we pass from a world à la Malthus to a world à la Solow?*

Auxiliary question: *Is the Solow' world sustainable?*

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Regime switch

It is easily identified using Gregory Clark's data on daily real wages of agricultural workers in England

Using historical sources, Clark calculates nominal wages, price index and real wages

Regime switch

Figure: Greg Clark (2002) "Farewell To Halms"

Regime switch

- Population data come from Wrigley and Schofield
- Black Death killed half of the European population during the 14th century
- Real wages in the agricultura sector exploded and then receded when population started to grow again

This is an illustration of Malthusian mechanisms

Demographic dimensions

Before entering into the details of each regime, one has to know that the take-off to modern economic growth has always been accompanied by a Demographic Transition.

Related question:

- Has the DT been the main driver of the take-off?
- A consequence of the take-off?
- Or do the two revolutions share common determinants?

La transition démographique

Definition

- A switch from a stable situation where population size is stable (or slowly moving) with high fertility and high mortality rates,
- to a stable situation where population size is stable (or moving slowly) again but fertility and mortality rates are low
- Most of the time, mortality shrinks first what makes population size increasing temporarily.

Theoretical DT

- Mortality shrinks first and fertility declines later
- In the meantime, the size of the population increases
- It makes the age structure of the population change: less kids, more workers and still very few elderlies $\rightarrow$ the dependency ratio declines $\rightarrow$ demographic dividend
- ... after some decades, more elderlies...

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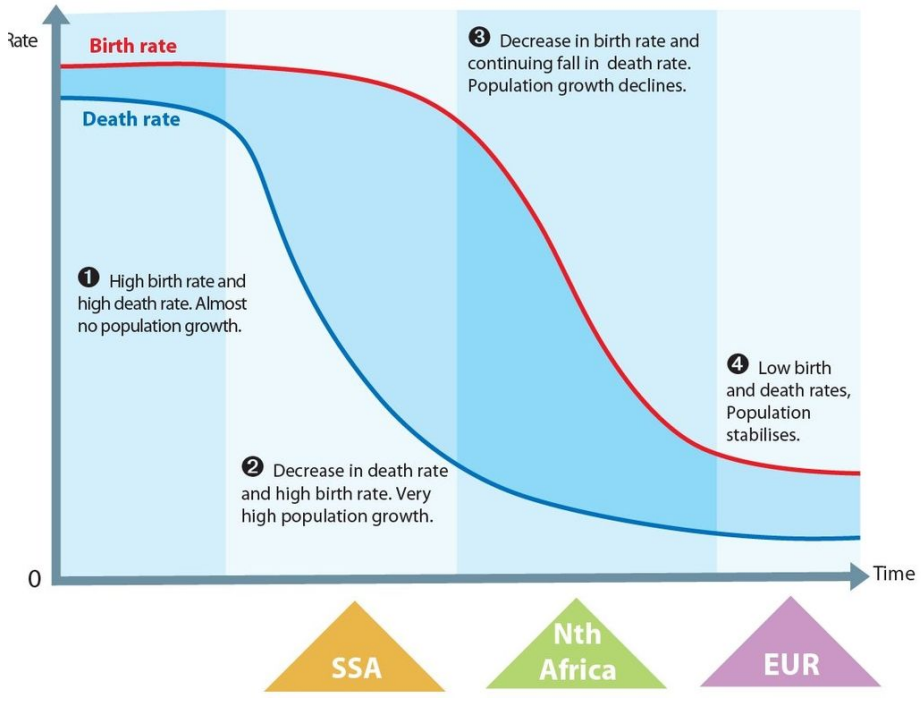
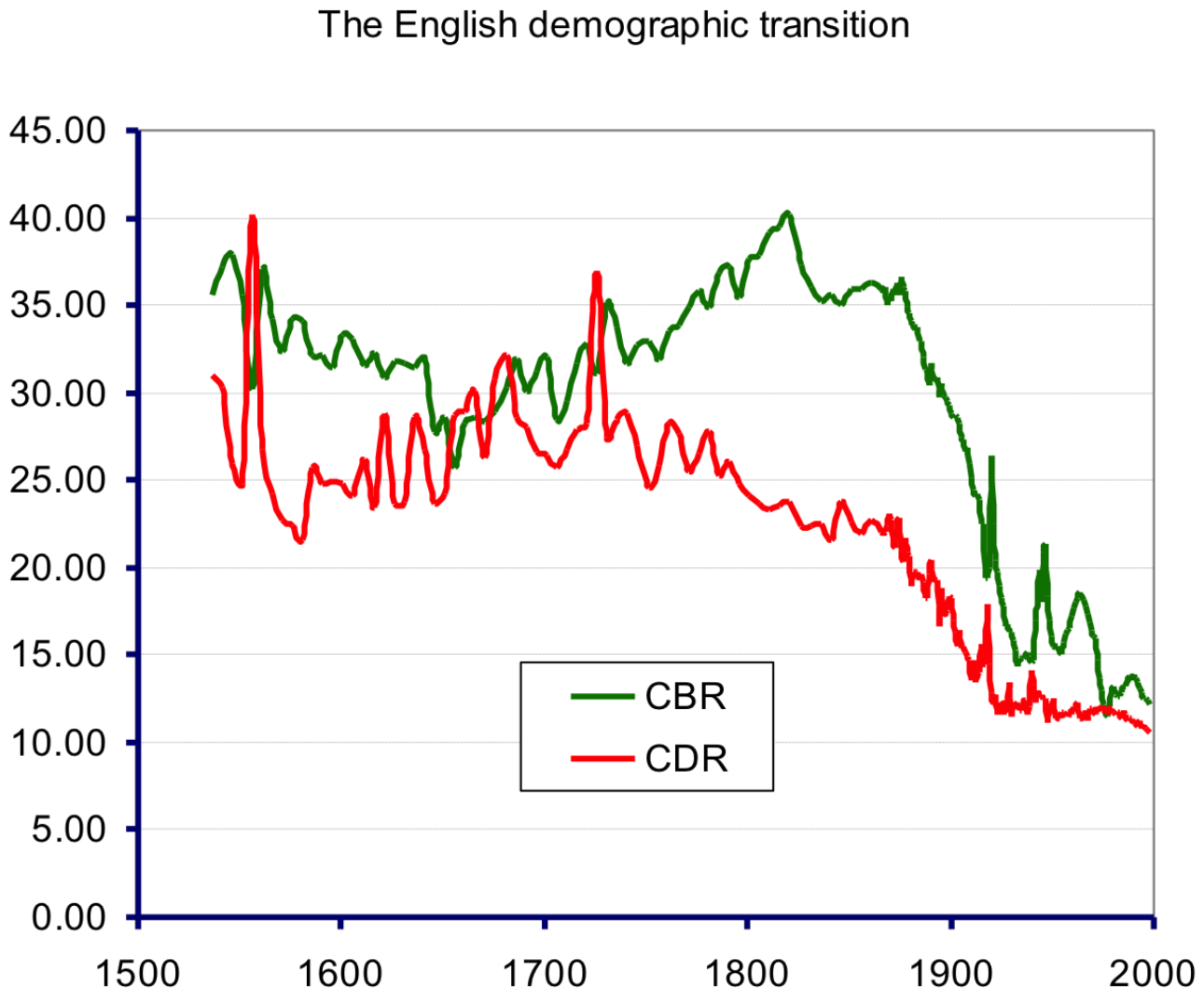
Graphical illustration



TD: facts


The English demographic transition
45.00
40.00
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25.00
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1600
1700
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1900
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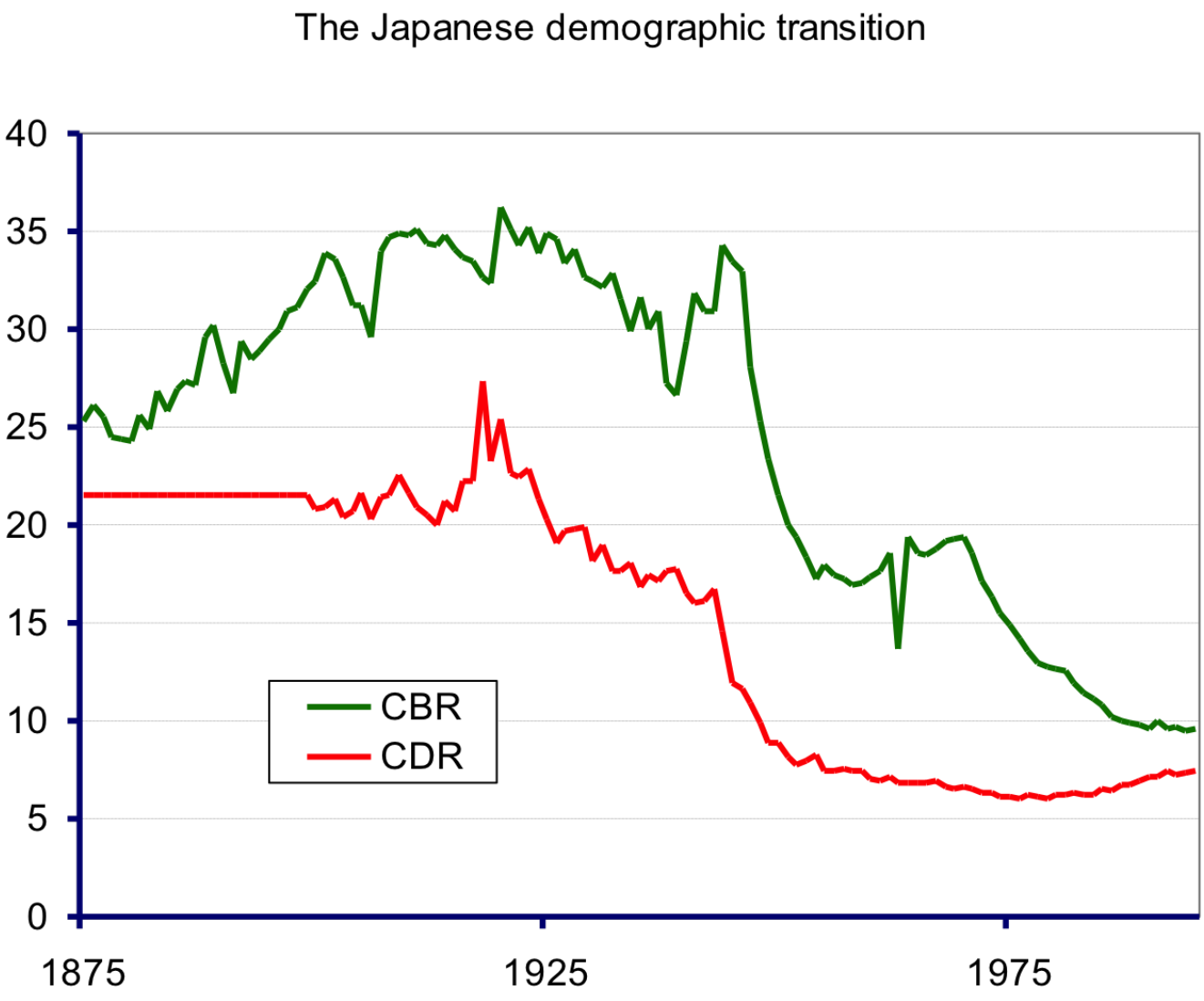
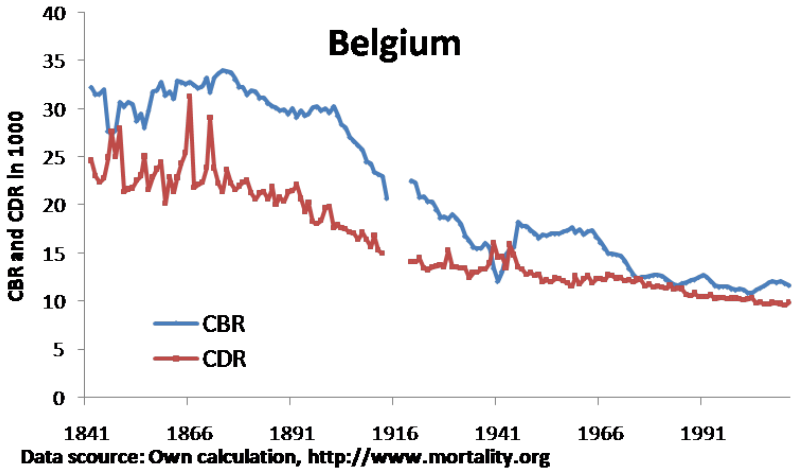
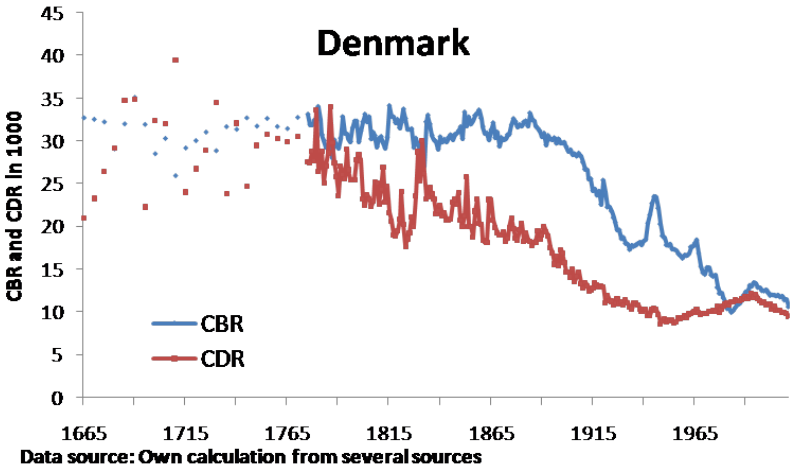
CBR
CDR

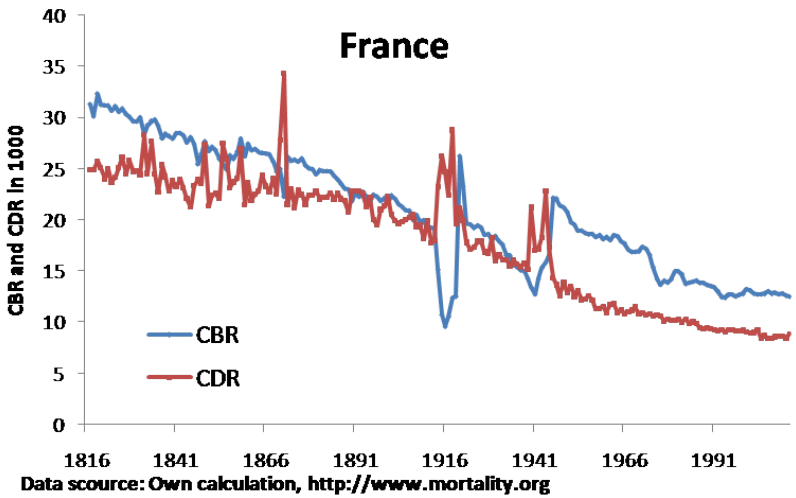
TD: facts

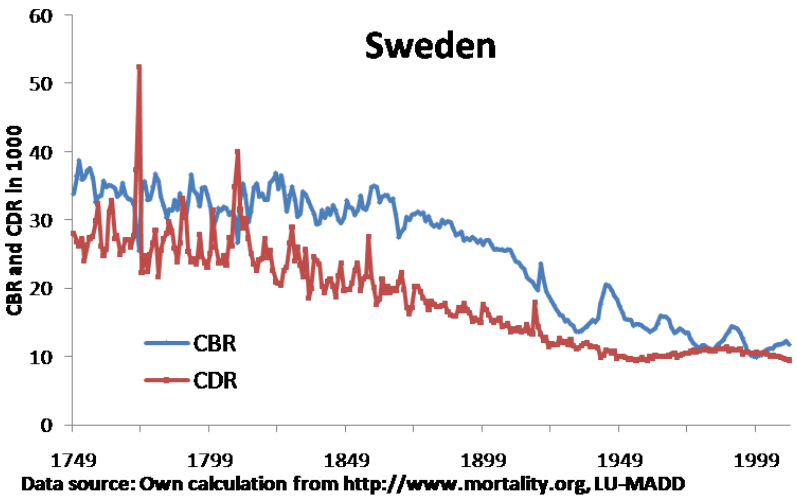

The Japanese demographic transition
40
35
30
25
20
15
10
5
0
1875
1925
1975
CBR
CDR

TD: facts


Belgium
CBR and CDR in 1000
CBR
CDR
Data source: Own calculation, http://www.mortality.org


Denmark
CBR and CDR in 1000
CBR
CDR
Data source: Own calculation from several sources


France
CBR and CDR in 1000
CBR
CDR
Data source: Own calculation, http://www.mortality.org


Sweden
CBR and CDR in 1000
CBR
CDR
Data source: Own calculation from http://www.mortality.org, LU-MADD

TD: facts

On remarque que:

- The demographic dividend is not automatic
- DT models are heterogenous (England, France, Japan)
- The later the transition the faster it is
- DT and economic take-off are intimately linked

Lenght of the transition

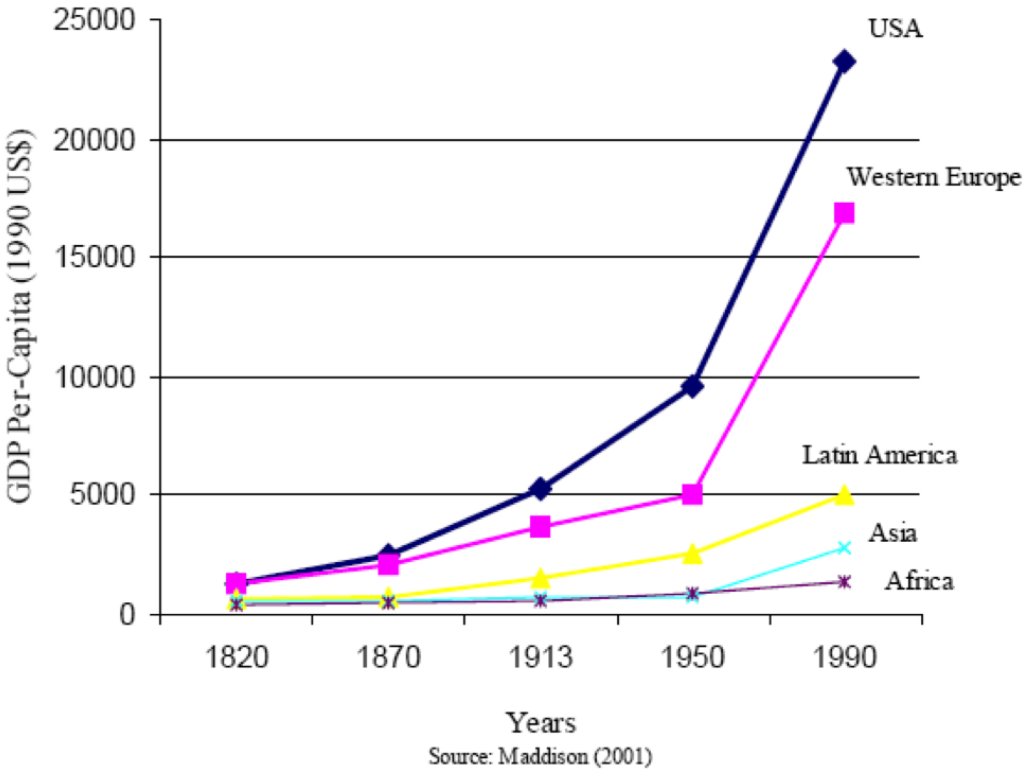
Some famous examples:

- England: two centuries
- Japan: less than a century
- Taiwan: half a century

Forerunners and stalls:

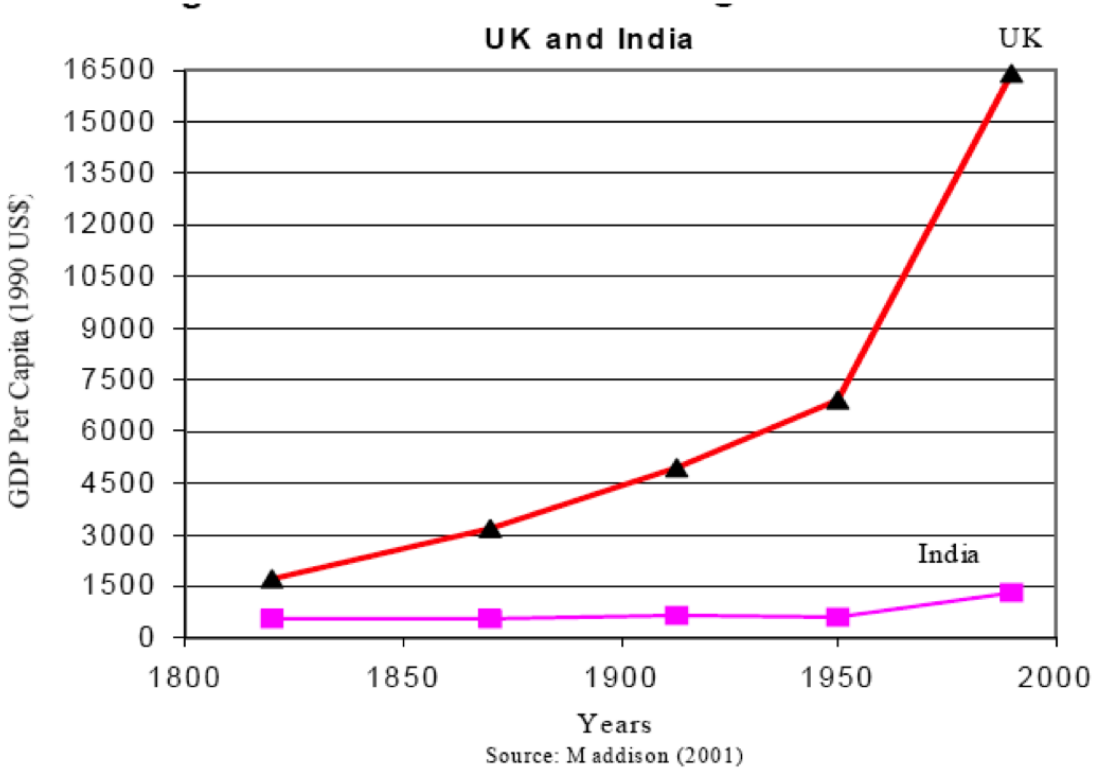
- DT has been first observed in Western Europe and it has widespread
- In Sub-Saharan Africa, fertility stalls are observed and discussed (see for instance Shapiro and Gebreselassie, 2013)

North-South economic and demographic divergence



Source: Maddison (2001)

North-South economic and demographic divergence



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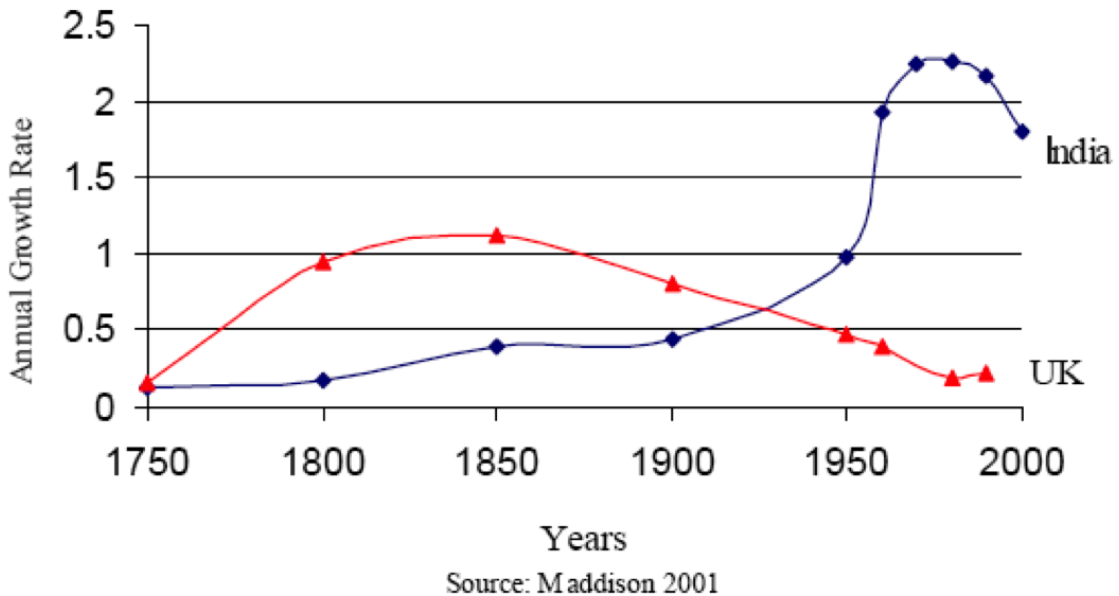

Source: Maddison 2001

The three regimes: details

In the following slides, we will:

- Dig into the empirics of the 3 regimes described by Galor and Weil (2000)
- Go well beyond usual economic measures of growth and development
- Try to get a first evaluation of the drivers of change

The Malthusian regime

This regime echoes the situation of poor countries today.
Applicable everywhere in the World before 1700.

- Slow growth of the population
- Almost no grwoth of income per capita in the long run (nothing at the scale of a human life)
- Standards of living depend on mortality and fertility (population size)
- Good institutions can help improving income in the short run but not in the long run
- Technology improves marginally and translates into variations in population size

Standard of living in the Malthusian regime

- Clark's data on real wages evidence strong variations but no growth
- Then, we are tempted to compare these wages to current data of poor countries and to earlier data from the ancient world

1800's England versus today's Malawi

Table 3.2 Wages and Prices in Malawi, 2001–2002, and England, 1800

	England, 1800 (pence)	England, 1800 (units per day)	Malawi, 2001–02 (kwacha)	Malawi, 2001–02 (units per day)
Wage	23.9	—	69	—
Prices				
Flour (kilograms)	7.5	3.2	33	2.1
Bread (kilograms)	5.9	4.0	46	1.5
Potatoes (kilograms)	1.2	20.4	16	4.2
Beef (kilograms)	17.4	1.4	123	0.6
Eggs (dozen)	11.1	2.1	84	0.8
Milk (liters)	2.4	9.9	48	1.4
Sugar (kilograms)	26.3	0.9	42	1.7
Beer (liters)	4.1	5.8	93	0.7
Tea (kilograms)	219.5	0.1	248	0.3
Salt (kilograms)	9.1	2.6	24	2.8
Cost of English basket	23.9	1.0	178	0.4

Sources: England: Clark, 2007b. Malawi: International Labour Organization, Bureau of Statistics, 2006a.

1800's England versus today's Malawi

- The average worker from Malawi today can afford only 40% of the basket of the basket of the average English worker from 1800 (food only)
- The poverty prevailing before the industrial revolution may have to be re-assessed...
- ... or that prevailing in Sub-Sharan Africa today

1800's England versus developing countries

Table 3.3 Comparative Incomes per Person, 2000

Country	Population, 2000 (millions)	Income per person (2005 $)	Relative income (%)	Population growth rate (%)	Life expectancy at birth, 2003
Tanzania	34	569	20	2.1	46
Burundi	7	717	25	2.9	44
Ethiopia	64	832	29	2.3	48
Sierra Leone	5	849	30	2.3	41
Malawi	10	935	33	2.4	40
Nigeria	127	956	34	2.4	43
Zambia	10	972	34	2.1	38
Madagascar	16	1,014	36	3.0	55
Rwanda	9	1,129	40	2.4	44
Burkina Faso	11	1,141	40	3.0	48
Mali	11	1,150	41	2.3	48
Benin	6	1,417	50	2.7	54
Kenya	30	1,525	54	2.6	47
Ghana	19	1,590	56	2.1	57
Nepal	23	1,809	64	2.2	62
Senegal	10	1,945	69	2.3	56
Bangladesh	131	2,052	73	2.2	63
Nicaragua	5	2,254	80	2.0	70
Côte d'Ivoire	16	2,345	83	2.0	46
Pakistan	138	2,497	88	2.2	63
Honduras	6	2,505	89	2.3	68
Moldova	4	2,559	90	0.3	68
Cameroon	15	2,662	94	2.0	46
England pre-1800	—	2,828	100	0.1	37
Zimbabwe	13	3,016	107	0.6	37
India	1,016	3,103	110	1.4	63
Bolivia	8	3,391	120	1.6	64
China	1,259	4,446	157	0.6	72

Sources: Income: Heston et al., 2006. Population: United Nations, 2006. Life expectancy: preindustrial England, table 5.2; others, United Nations, Development Program, 2005,

1800's England versus Antic societies

1800's England was less rich that many antic societies

Table 3.4 Laborers' Wages in Wheat Equivalents

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

Sources: [a]Powell, 1990, 98; Farber, 1978, 50–51. [b]Zaccagnini, 1988, 48. [c]Jevons, 1895, 1896. [d]Rathbone, 1991, 156–58, 464–45. [e]Clark, 2005. [f]Clark, 2001b.
Note: * denotes farm wage.

Demography of the Malthusian regime

- Cliché of large families...
- Before 1800, net fertility was close to 2
- World population:
  - 0.1 million in 130000 BCE
  - 770 millions in 1800

  It gives 2.005 surviving kids per woman
- but it hides an extreme situation of high fertility and high child and teenage mortality

Fertility the Malthusian regime

Table 4.1 Annual Birth Rate, Married Women, Europe before 1790

Country or group	Birth rate at age: *20–24*	*25–29*	*30–34*	*35–39*	*40–44*	All births (20–44)
Hutterites	0.55	0.50	0.45	0.41	0.22	10.6
Belgium	0.48	0.45	0.38	0.32	0.20	9.1
France	0.48	0.45	0.40	0.32	0.16	9.1
Germany	0.45	0.43	0.37	0.30	0.16	8.6
Switzerland	0.45	0.38	0.34	0.22	0.16	7.8
Scandinavia	0.43	0.39	0.32	0.26	0.14	7.7
England	0.43	0.39	0.32	0.24	0.15	7.6

Source: Flinn, 1981, 86.

Fertility the Malthusian regime

- This is the mean number of births per married woman per year for a specific age class
- Out-of-wedlock births amount for only 3% of all births
- European annula birth rates were close to those of the Hutterites who are Anbaptists of German origins settled in Canada today
- So it's not the average number of kids per woman
- Age at marriage was the way to regulate births at that time

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Age at first marriage in the Malthusian regime

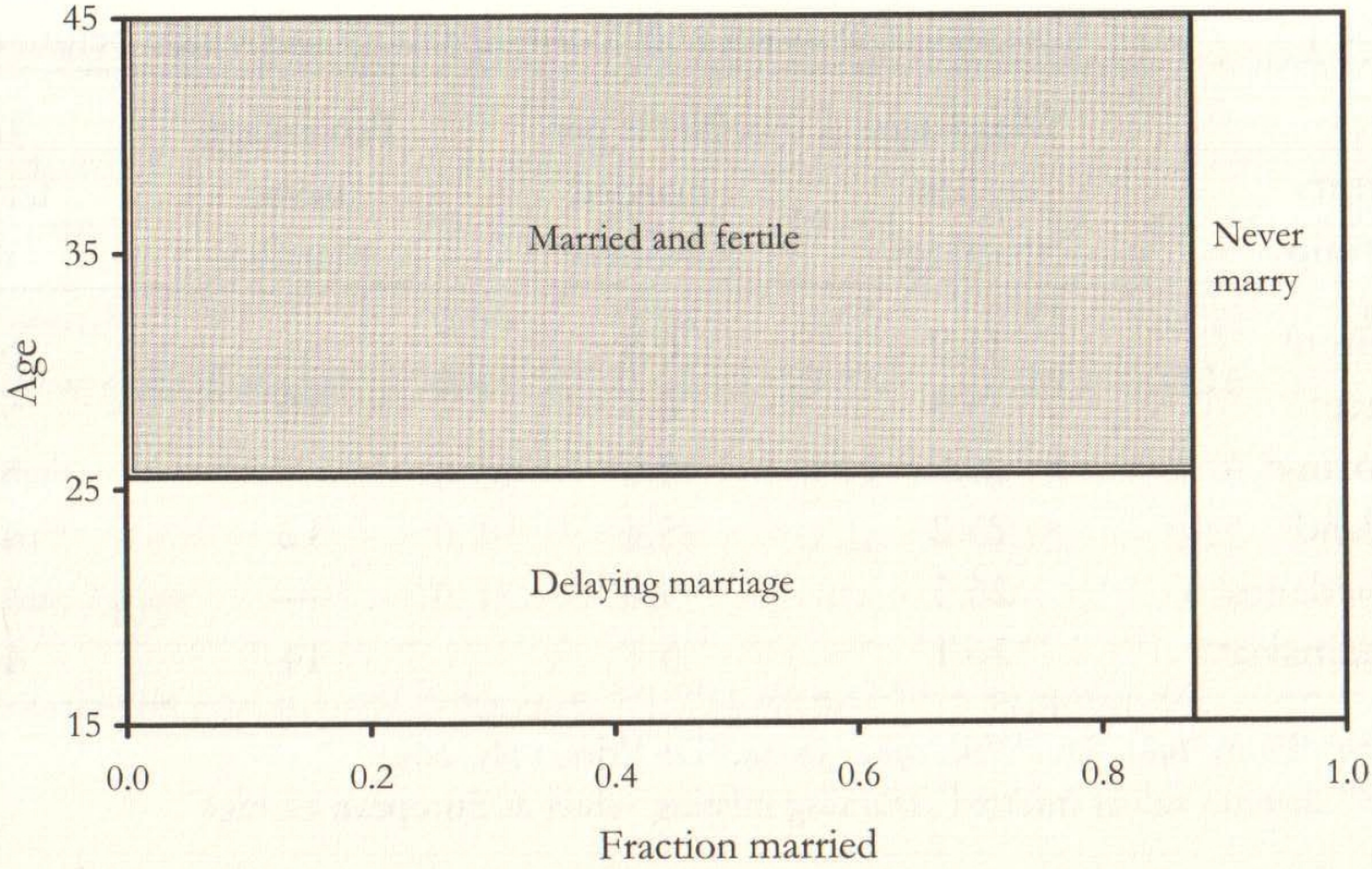

Figure 4.1 The European marriage pattern and fertility.

Age at first marriage in the Malthusian regime

Table 4.2 Age of Marriage of Women and Marital Fertility in Europe before 1790

Country or group	Mean age at first marriage	Births per married women	Percentage never married	Total fertility rate
Belgium[a]	24.9	6.8	—	6.2*
France[a,b]	25.3	6.5	10	5.8
Germany[a]	26.6	5.6	—	5.1*
England[a]	25.2	5.4	12	4.9
Netherlands[c]	26.5	5.4*	—	4.9*
Scandinavia[a]	26.1	5.1	14	4.5

Sources: [a]Flinn, 1981, 84. [b]Weir, 1984, 33–34. [c]De Vries, 1985, 665.
Note: * denotes values inferred assuming missing values at European average.

Differential fertility in the Malthusian regime

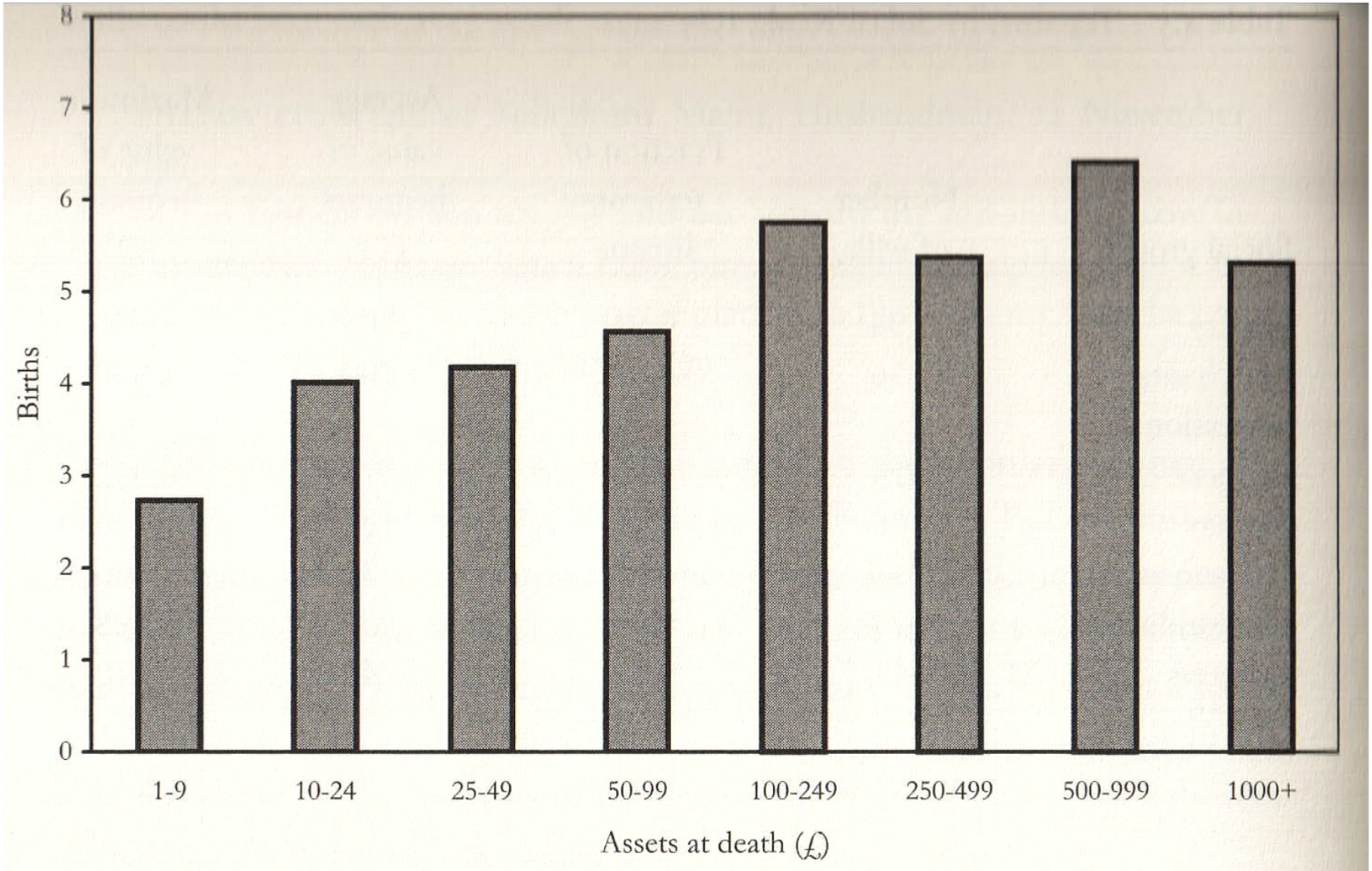

Figure 4.3 Births per man in England, by wealth at death.

Differential fertility in the Malthusian regime

- The richest halve of the population has produced 40% more kids that the poorest halve
- Why?
  - The rich have more chances to marry early and to live long (to be nuanced)
  - Main: **per year of marriage**, the rich have more kids than the poor this is the main reason and it is due to income effects
- The rich English man in 1800 who marry early has as many children as an Hutterite

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Mortality in the Malthusian regime

General view:

- Mortality is high
- Life expectancy at birth is around 35 years
- But infant, child and teenage mortality rates are very high at age 20, life expectancy is still 35 years
- Higher mortality in cities than in the countryside

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Mortality in the Malthusian regime

Table 5.2 Life Expectancy in Agrarian Economies

Group	Life expectancy at birth (e_0)	Life expectancy at age 20 (e_{20})	Infant mortality (%)	Deaths at ages 0–15 (%)
Western Europe				
Italy (medieval Pistoia)[a]	29	25	21	56
England, 1550–99[b]	38	33	18	30
England, 1650–99[b]	35	31	18	32
France, 1750–89[c]	28	—	21	—
England, 1750–99[b]	38	34	17	30
East Asia and Africa				
Egypt (rural), 11–257[d]	28	21	—	45
China (Anhui), 1300–1880[e]	28	33	—	—
China (Beijing), 1644–1739[e]	26	30	—	—
China (Liaoning), 1792–1867[e]	26	35	—	—
Rural Japan, 1776–1815[f]	33	37	25	50
Urban				
Egypt (urban), 11–257[d]	24	17	—	48
London, 1750–99[g]	23	—	30	—

Mortality in the Malthusian regime: some comparisons

Table 5.1 Life Expectancy for Modern Foragers

Group	Life expectancy at birth (e_0)	Life expectancy at age 20 (e_{20})	Infant mortality (%)	Deaths at ages 0–15 (%)
Ache, Paraguay[a]	37	37	12	34
Kutchin, Yukon[b]	35*	—	17	35
Hadza, Tanzania[b]	33	39	21	46
!Kung, Ngamiland, Botswana[b]	32*	—	12	42
!Kung, Dobe, Botswana[b]	30	40	26	44
Agta, Philippines[b]	24	47	37	49

Sources: [a]Hill and Hurtado, 1996, 196. [b]Pennington, 2001, 192.
Note: * denotes values estimated from share of population dying by age 15.

Mortality in the Malthusian regime: some comparisons

- The perspective of a hunter-gatherer today are better than those of the average English person in 1800
- The Black-Death devastated the European population between 1300 and 1600
  - But longevity came back rapidly to its previous levels
  - The stock of population has been reduced durably
  - The Black-Death is reputed to have benefited the later generations: this is a crucial Malthusian fact

The Post-Malthusian regime: facts

- Population grows faster
- Income per capita starts to grow slowly
- Agricultural Revolution in England $\rightarrow$ enclosure acts
- Rural exodus
- Urbanization et temporary pauperization

The modern growth regime

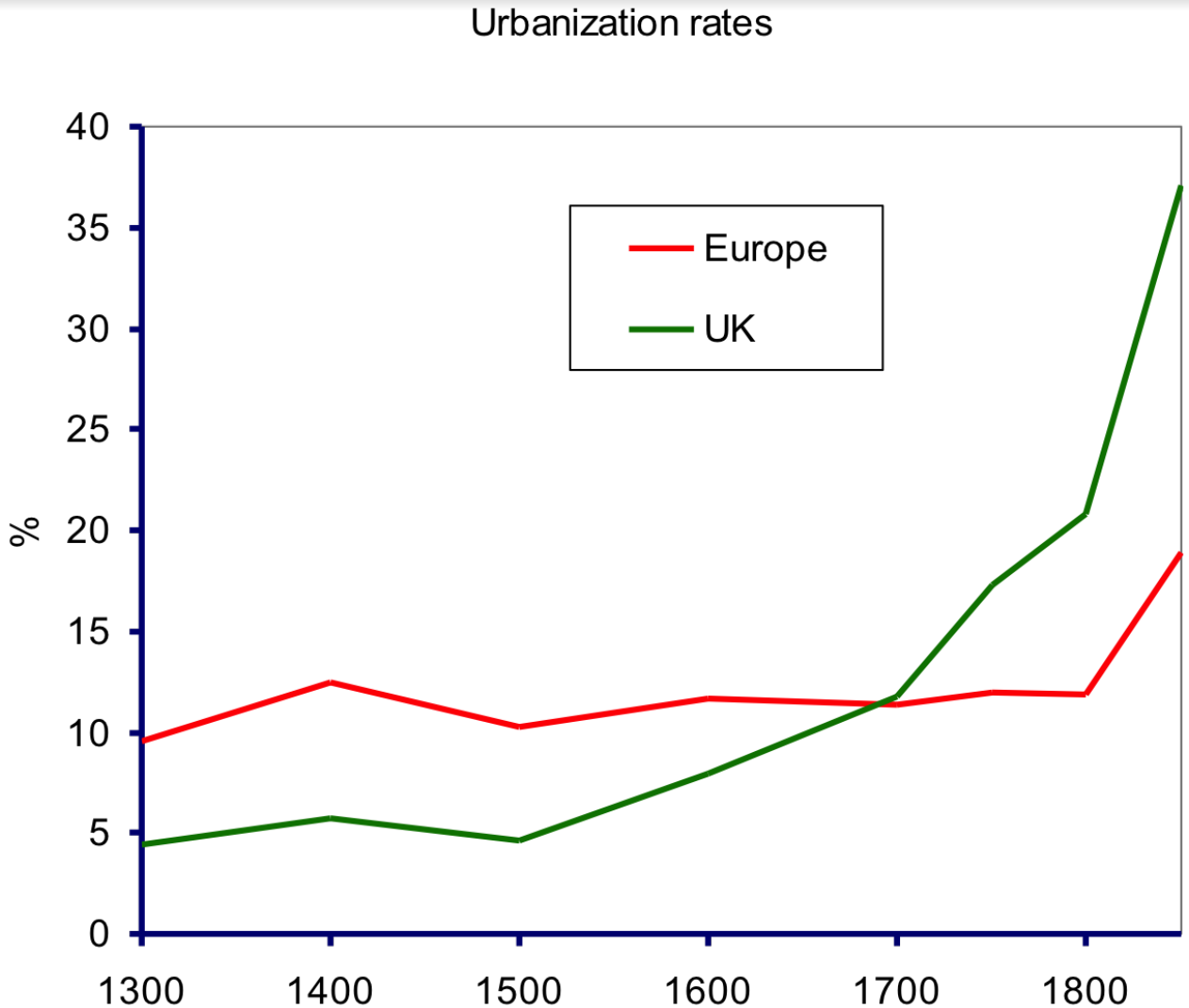
Taux de croissance annuels moyens:

Table 0.3: Taux de croissance annuel moyen par sous-périodes (en %)

	[1820,1870]	[1870,1913]	[1913,1950]	[1950,1973]	[1973,1989]
France	0,8	1,3	1,1	4,0	1,8
Allemagne	0,7	1,6	0,7	4,9	2,1
Royaume-Uni	1,2	1,0	0,8	2,5	1,8
Etats-Unis	1,5	1,8	1,6	2,2	1,6
Japon	0,1	1,4	0,9	8,0	3,1
Italie	0,4	1,3	0,8	5,0	2,6

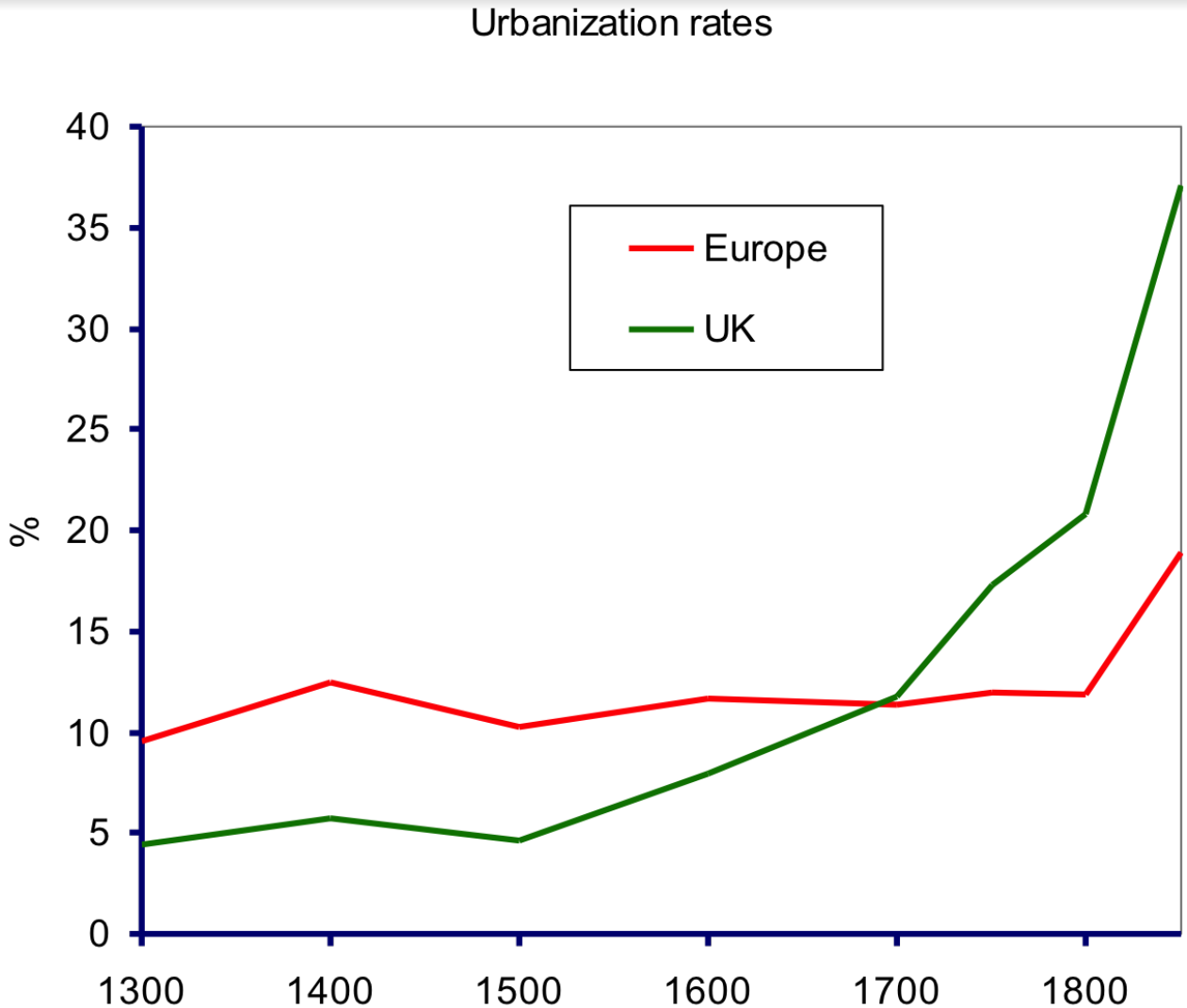
Source Maddison [1991]

Urbanization



The question of urbanization without economic development is present in Africa today

Urbanization

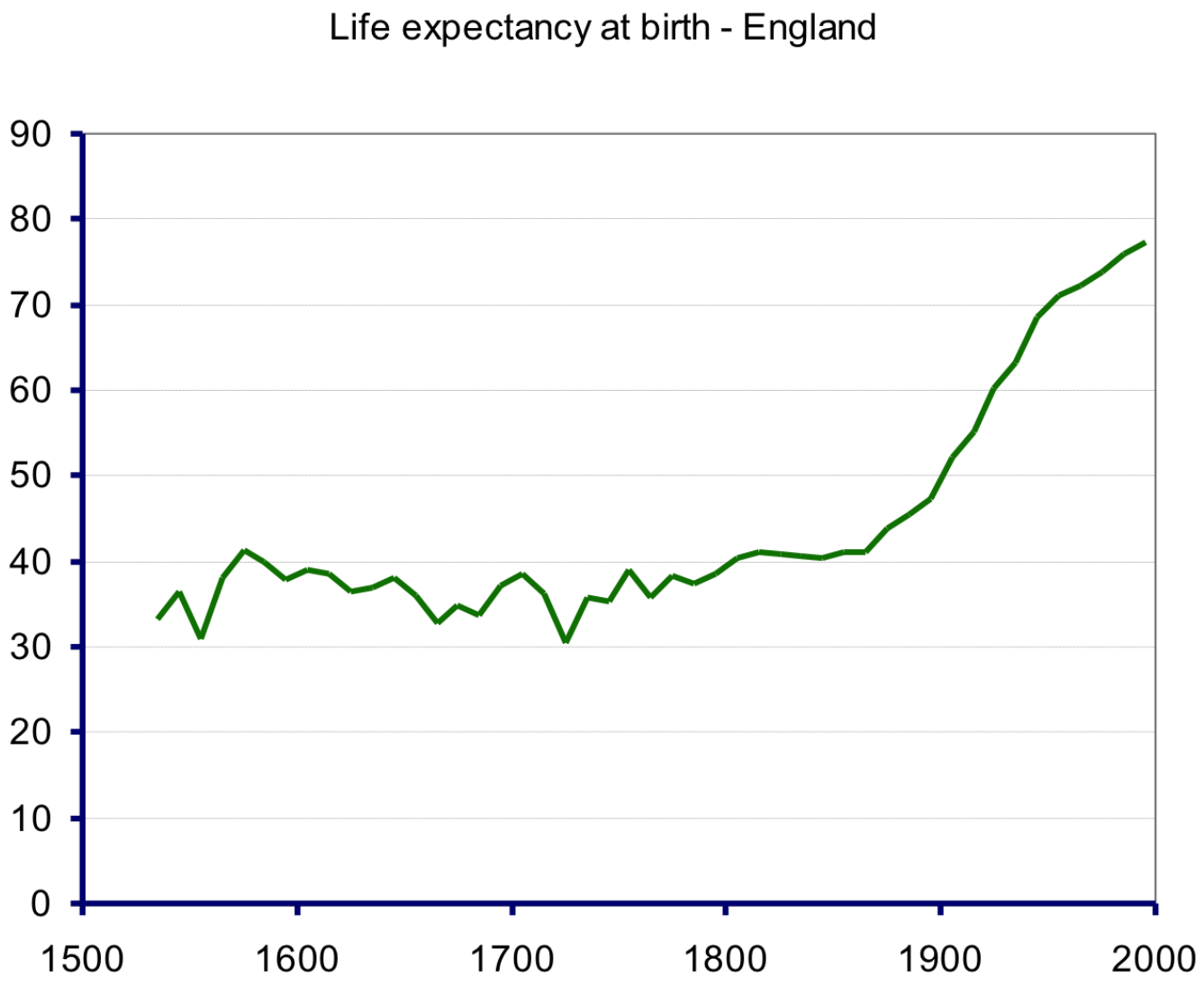


The question of urbanization without economic development is present in Africa today

Rise in education

	1820	1870	1913	1950	1973	1992
Angleterre	2.00	4.44	8.82	10.60	11.66	14.09
France			6.99	9.58	11.69	15.96
Allemagne			8.37	10.40	11.55	12.17
Belgique				9.83	11.99	15.24

Life expectancy



The reasons of the take-off

Can we identify the reasons of the take-off thanks to data?

At least we can try and get some first ideas

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Educational data

- Around 1600, only very few persons were able to write their name to sign on registries
- Continuous improvements between 1600 and1800 (England, France)
- Compulsory education emerges around 1870

Les données sur l'éducation

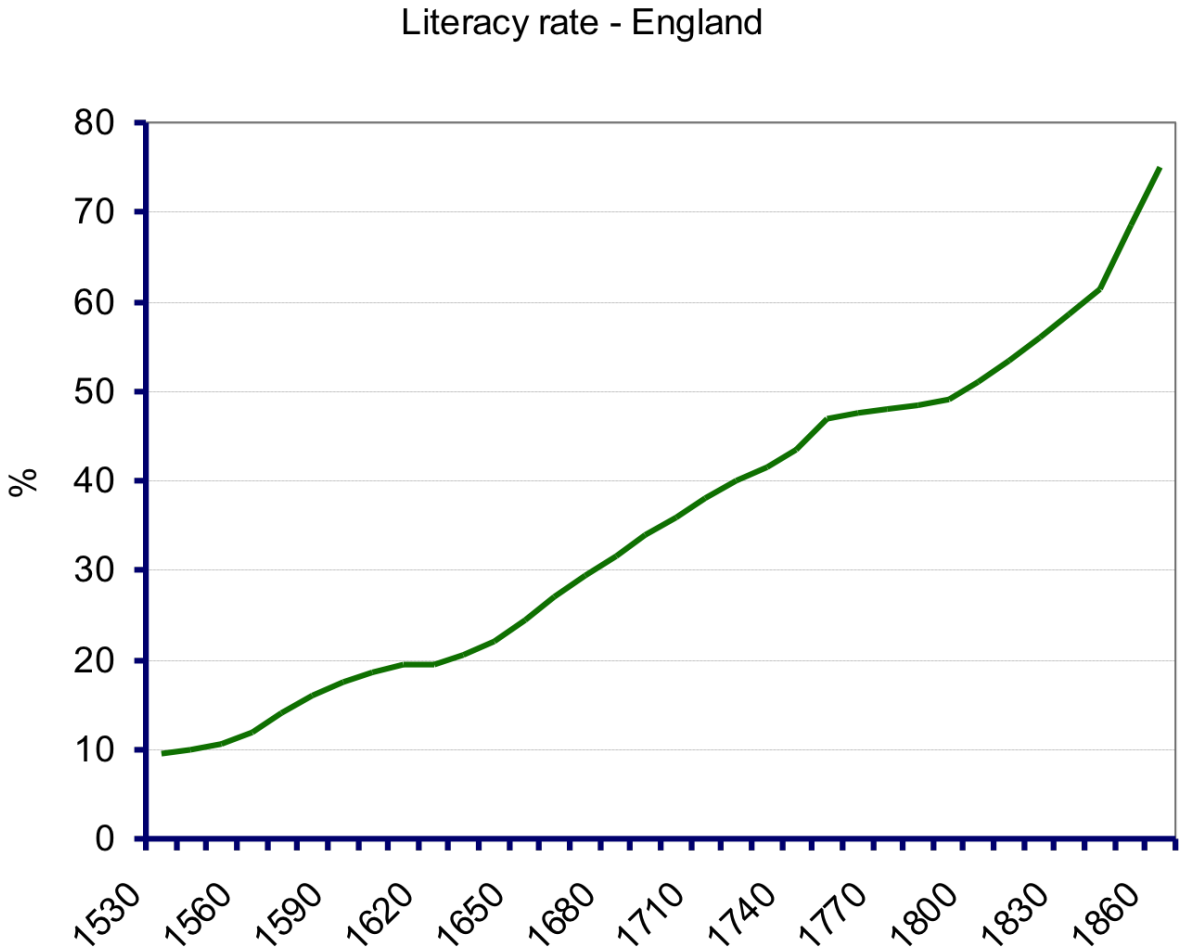

Figure: Source:

But what can explain the rise of education?

- Institutions
- Longévité (avant la RI)
- Demande accrue de personnes qualifiées suite à la RI

Why institutions?

Institutions and education echo the notion of conflict.

Landowner, education and institutions - Galor et al (2011) or Engerman and Sokoloff (2007)

Two modes of production before the IR:

- Agriculture: working on land does require an educated workforce
- Industries: requires an educated workforce when technologies improve

Conflict:

- Landowner don't want to fund public education
- Industrial entrepreneurs want everybody to fund public education

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Les institutions - Exemple de rôle

The result of the conflict depends on the distribution of economic power and wealth in the population: in economies dominated by few and powerful landowners, no public education and less, if not, no growth

Data from Engerman and Sokoloff (2007)

Country	year	%
Mexico	1910	2.4
United States	1900	74.5
Canada	1901	87.1
Argentina	1885	20

Les institutions - Exemple de rôle

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Longevity and mortality

Returns to education depend on the time during which people can use it

So it depends on longevity $\rightarrow$ "Ben Porath" effect

An exogenous increase in longevity should increase investments in human capital and so stronger growth

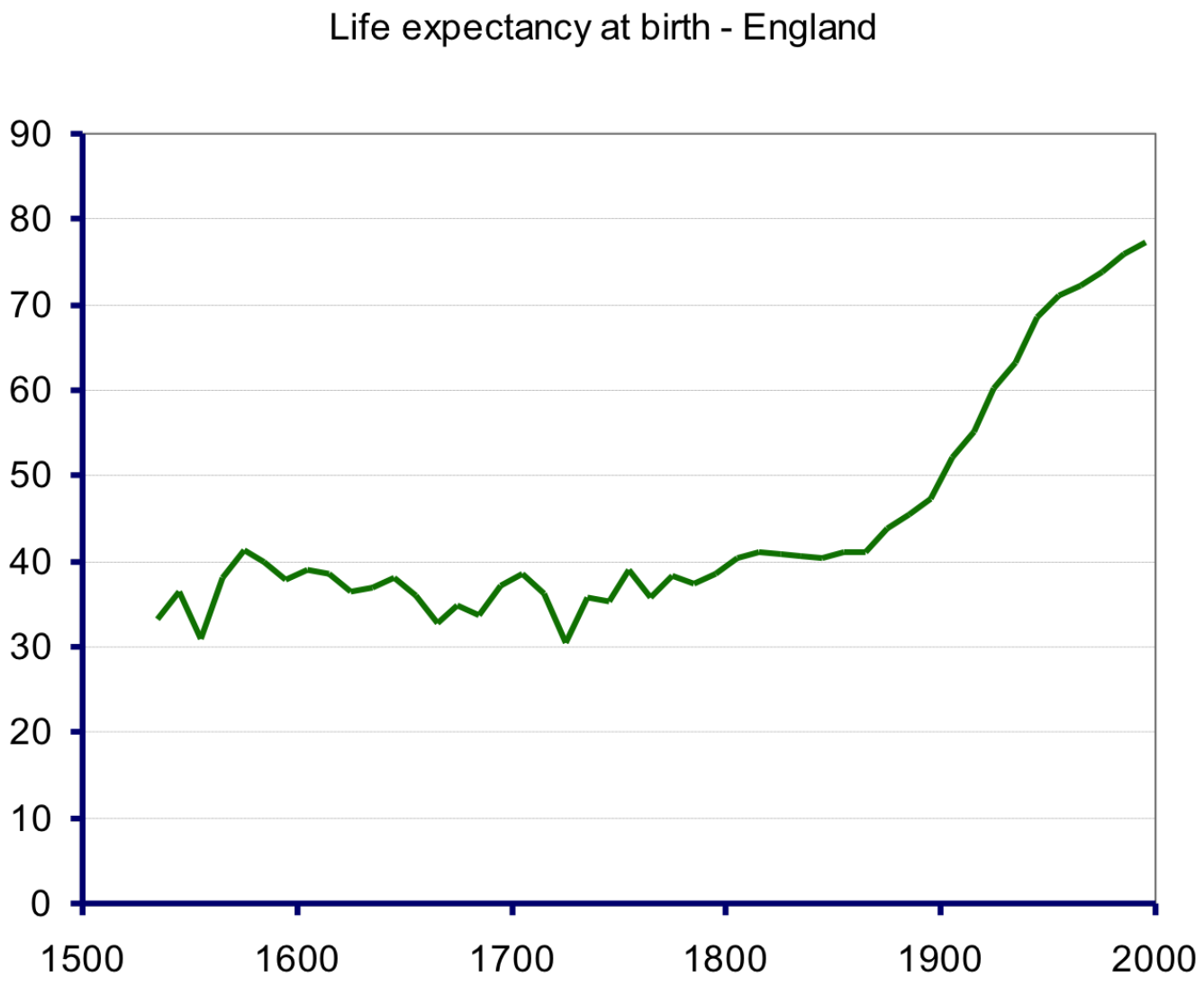
Longevity and mortality - data

Definition: life expectancy at birth is the number of years a newborn can expect to live if current death rates hold unchanged

Trends:

- No improvement before 1800
- But variance reduction

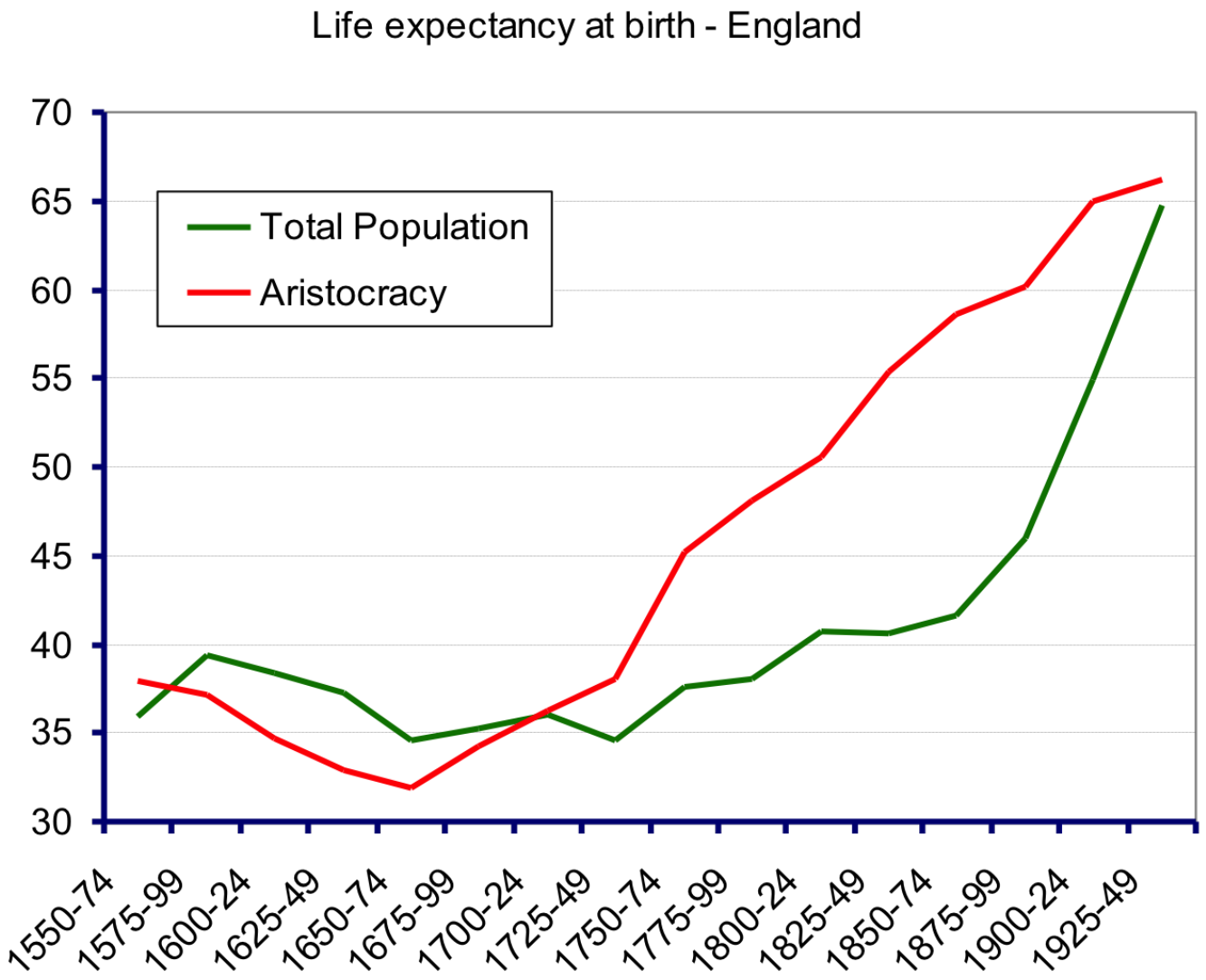
Longevity and mortality - data



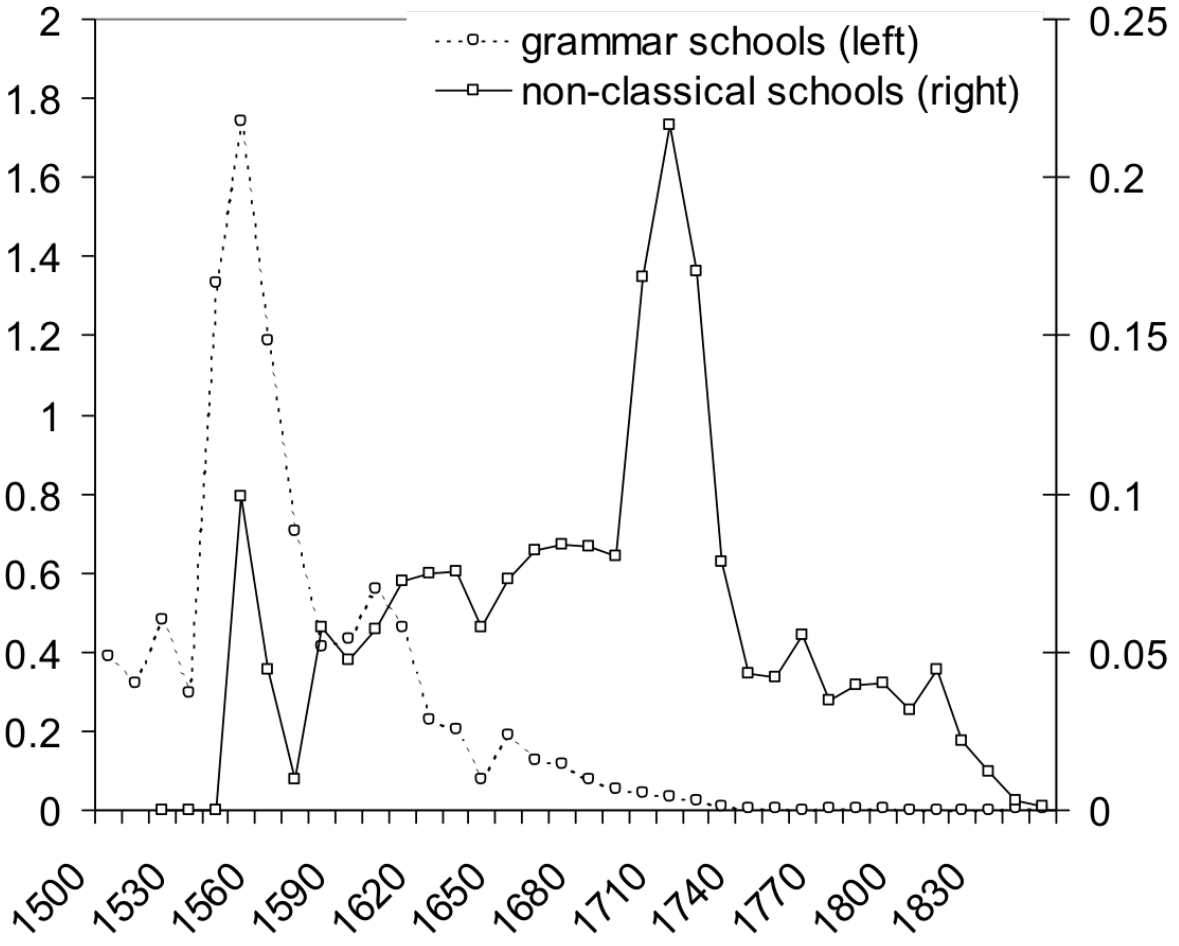
Longevity and mortality - data

- The rise in education has started well before the rise in longevity: during the 16th century
- The rise in longevity seems unable to explain the rise in education
- But data are misleading

Longevity and mortality - data



Longévité et mortalité - les données



Demand of human capita by the market

The technological frontier has constantly progressed since the IR and it demands more and more qualified workers

Data from Mokyr:

TABLE 1.1 Estimated Annual Rates of Growth, 1700-1871
(in percentages)

Period	National Income per cap. (Deane & Cole)	National Income per cap. (Crafts)	Indust. Product (Hoff-mann)	Indust. Product (Deane & Cole)	Indust. Product (Harley)	Indust. Product (Crafts)	Indust. Product (Cuenca)
1700-1760	0.44	0.3	0.67	0.74	n.a.	0.62	--
1760-1800	0.52	0.17	2.45	1.24	1.6[a]	1.96	2.61[c]
1800-1830	1.61	0.52	2.70	4.4	3.2[b]	3.0	3.18
1830-1870	1.98	1.98	3.1	2.9	n.a.	n.a.	

a - 1770-1815
b - 1815-1841
c - 1770-1801

SOURCE: Computed from Harley (below); Hoffmann (1965); Cuenca (1994).

Demand of human capita by the market

Is this compatible with the DT?

YES:

- The rise in education reduces mortality and especially infant and child mortality
- It reduces fertility because of the quality-quantity trade-off
- Longevity is increased
- Nevertheless, the population needs to be ready for that change (culture matters)

Demand of human capita by the market

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Conclusion

Data indicate that there are usual suspects to explain the take-off to modern economic growth but finding Kaïser Sauzé necessitates a robust quantitative theory of economic growth (see Brian Singer, 1995 and Oded Galor, 2011 and 2017)