

Tropical biodiversity conservation :

part 1 general introduction



VOJTECH NOVOTNY:
TROPICAL ECOLOGY,
LECTURE NO 15.
University of S. Bohemia
Charles University
Palacky University

Hieronymus Bosch
The garden of earthly delights
1490-1500

What do we want from biodiversity conservation?

- we have no right to harm living organisms and ecosystems (**moral argument**)
- biodiversity is an interesting and aesthetically pleasing product of evolution that we cannot re-create (**biophilia**)
- biodiversity is essential for healthy life in a pleasing environment (**health motivation**)
- biodiversity has current or future economic value (**utilitarian argument**)
- biodiversity conservation is a vehicle for return to the “natural state” of human civilization and anti-capitalist movement (**social engineering**)

Conservation is philosophy and politics,
but science should provide alternative scenarios to choose from



Primary problem of human planetary impact:

Growing human population

Secondary problems: everything else

Species extinctions

Pollution [including climate change]

Non-sustainable resource use [freshwater, soil, marine fisheries]

Habitat destruction and fragmentation

Alien biota ... and others



“It’s our population growth that underlies just about every single one of the problems that we’ve inflicted on the planet. – Jane Goodall

"All our environmental problems become easier to solve with fewer people, and harder - and ultimately impossible - to solve with ever more people.“ – Sir David Attenborough



Primary problem of human planetary impact:

Growing human population

Counter-argument

Developed countries cause most of the environmental damage

This is due to their high per capita ecological footprint

Poor people do not matter environmentally

Counter counter-argument

Poor people of today, and their children, are:

- rich people of tomorrow, therefore environmentally significant
- poor people of tomorrow: not acceptable

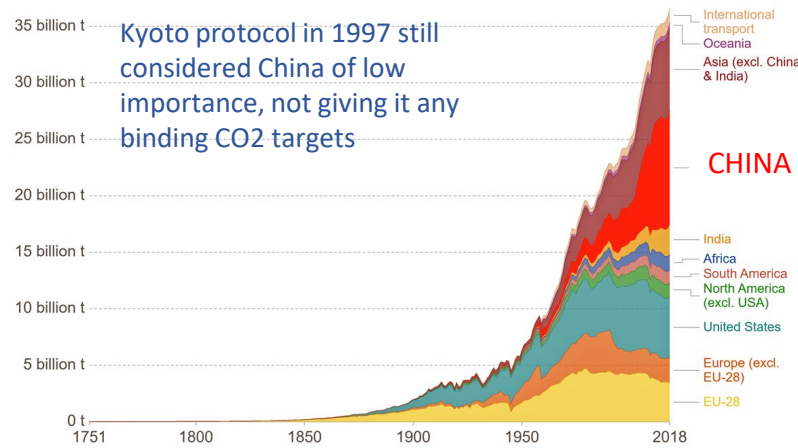
The argument that focus on population is wrong, neocolonialist or even racist implicitly assumes that there will never be economic advancement for poor people

Why population size in poor countries matters:

China transformation from 1950 to 2019 from insignificance to the most polluting country

Annual total CO₂ emissions, by world region

This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included.

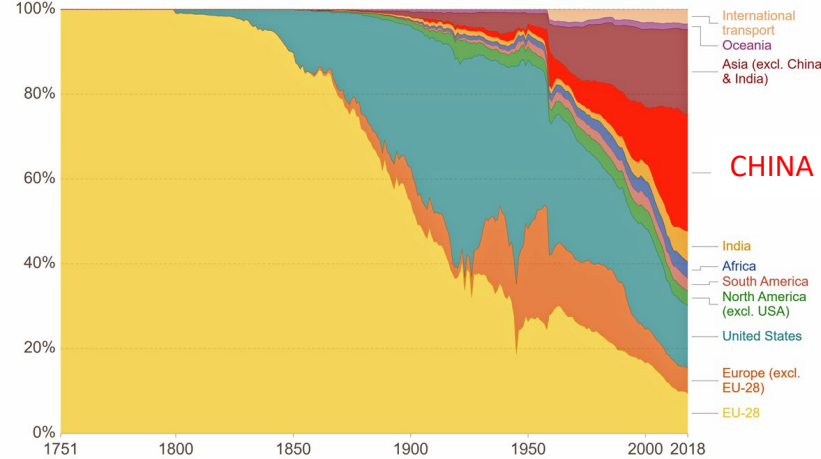


Kyoto protocol in 1997 still considered China of low importance, not giving it any binding CO₂ targets

Our World in Data

Annual total CO₂ emissions, by world region

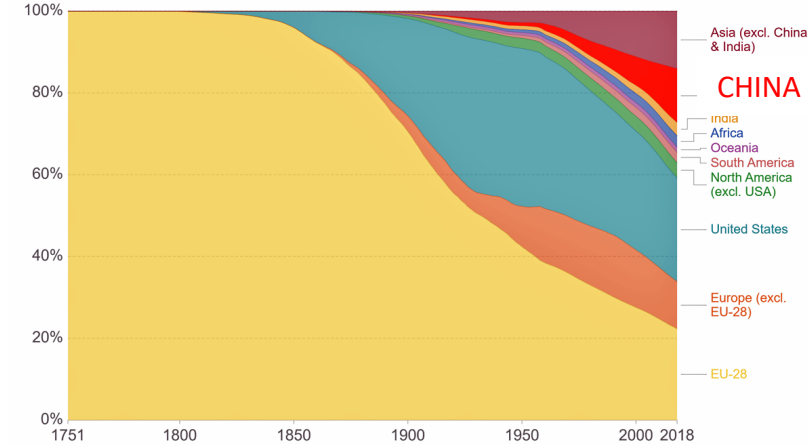
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Our World in Data

Cumulative CO₂ emissions by world region

Cumulative carbon dioxide (CO₂) emissions by region from the year 1751 onwards. Emissions are based on territorial emissions (production-based) and do not account for emissions embedded in trade. This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included.

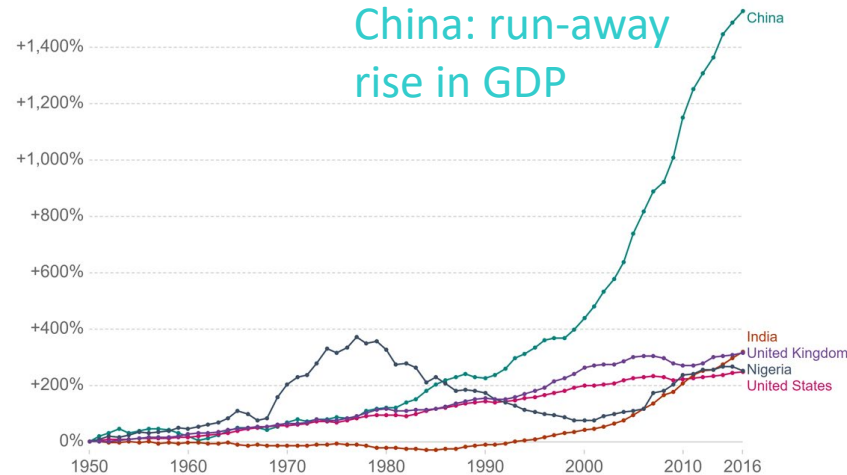


Our World in Data

China is now the single highest CO₂ emitter

Change in GDP per capita, 1950 to 2016

GDP per capita adjusted for price changes over time (inflation) and price differences between countries – it is measured in international-\$ in 2011 prices.

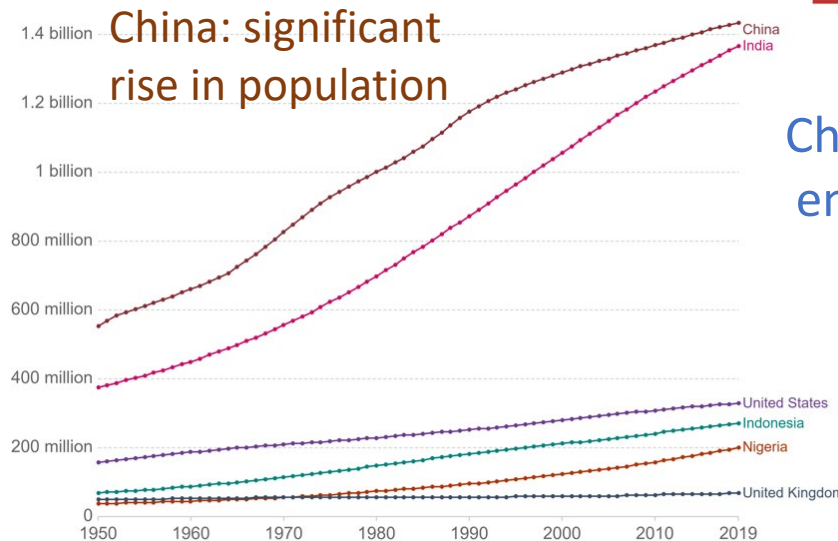


China: run-away rise in GDP

Our World in Data

China equals USA + EU28 in CO₂ production

Population, 1950 to 2019



China: significant rise in population

Our World in Data

China is no 3 when counting historical CO₂ but closing the gap with USA and Europe

China's rise changed the politics of CO₂ emissions from being "the fault of rich countries" to a more complex one

Current prominence of China as a polluter is a result of its large population AND 1500% increase of GDP relative to 1950

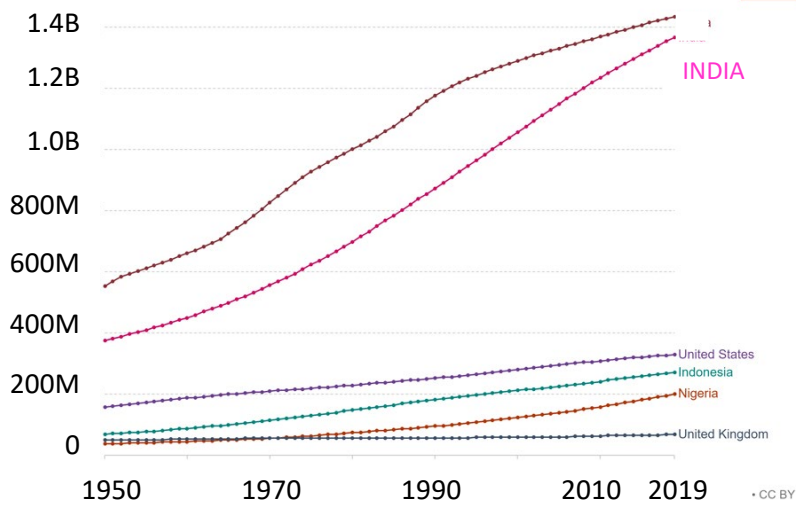
Source: Maddison Project Database (2018) OurWorldInData.org/economic-growth • CC BY
Note: These series are adjusted for price differences between countries using multiple benchmark years, and are therefore suitable for cross-country comparisons of income levels at different points in time.

Source: Gapminder; HYDE & UN Population Division (2019) OurWorldInData.org/world-population-growth • CC BY

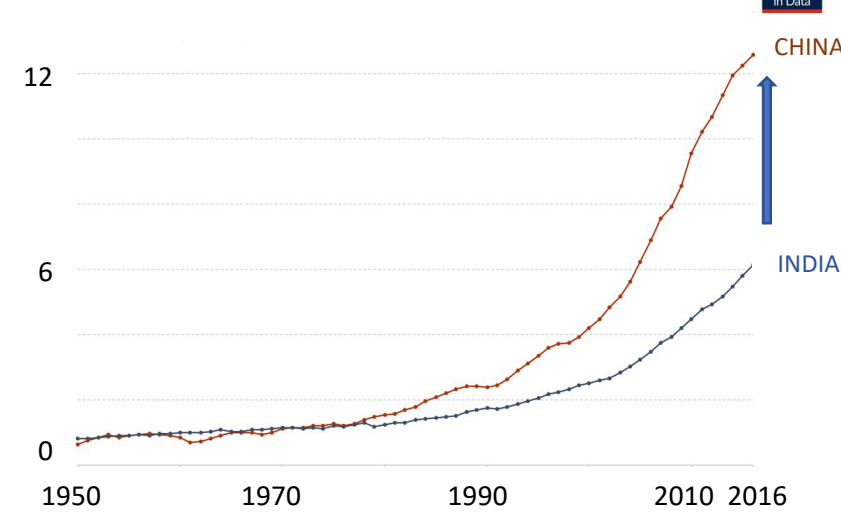
Is India going to be the next China?



Population, 1950 to 2019



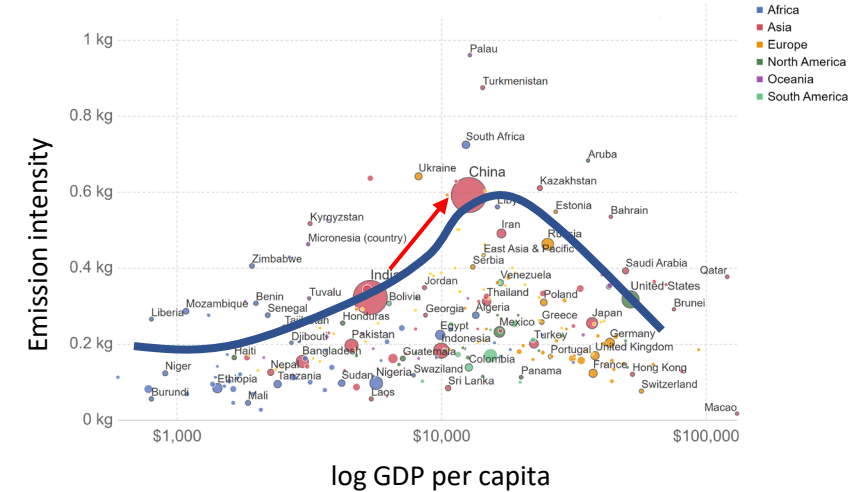
GDP per capita, \$thousands, 1950 to 2016



India will soon overtake China in population

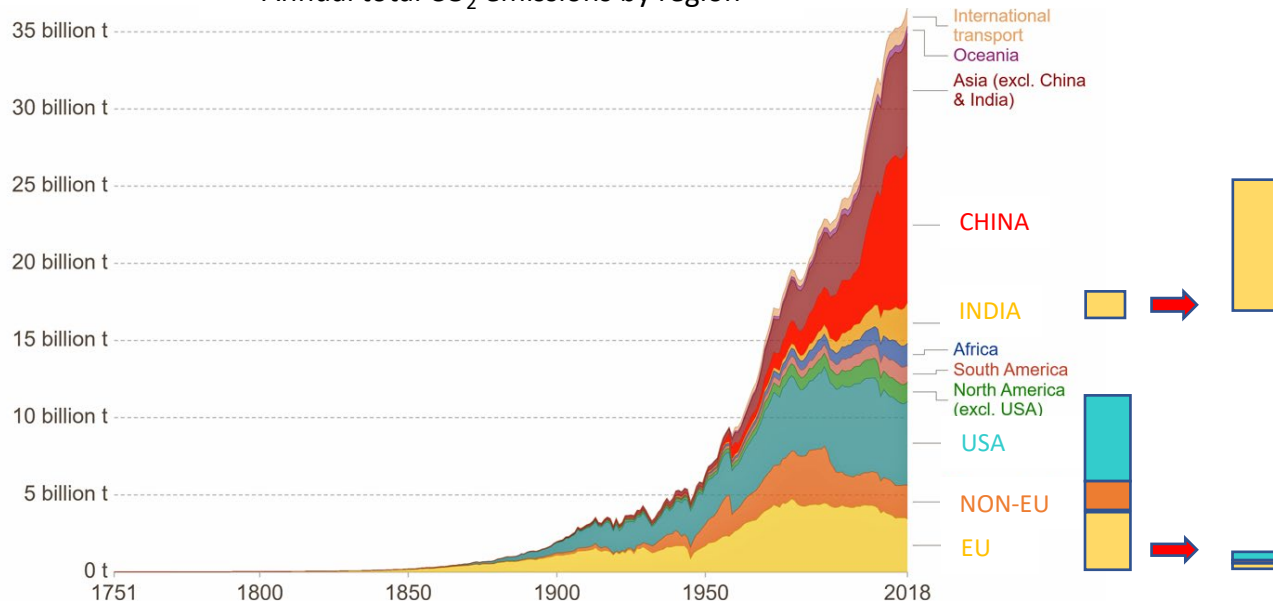
If it reaches the same GDP growth as China

Carbon emission intensity vs GDP per capita, 2014



at the same CO2 production efficiency as China

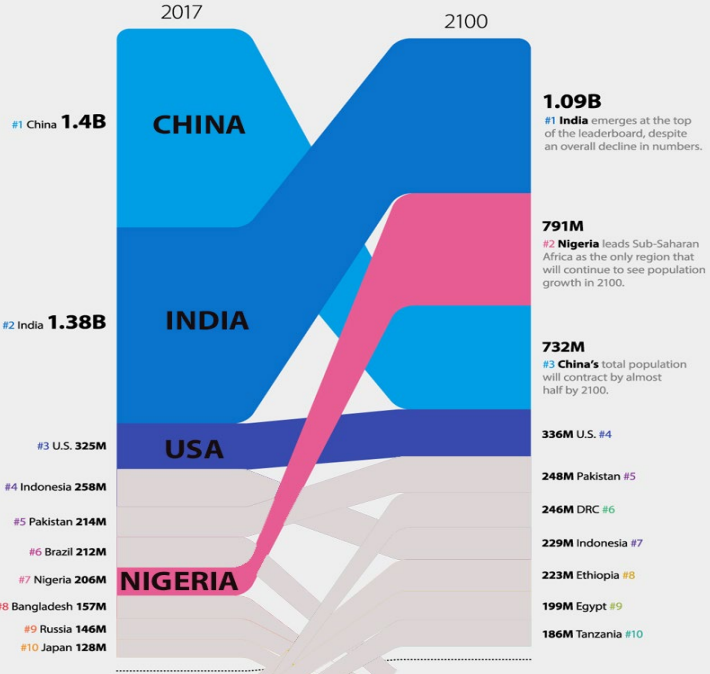
Annual total CO₂ emissions by region



then the increase in Indian emissions to the China level would nearly wipe out gains from the entire Europe + USA going carbon-neutral

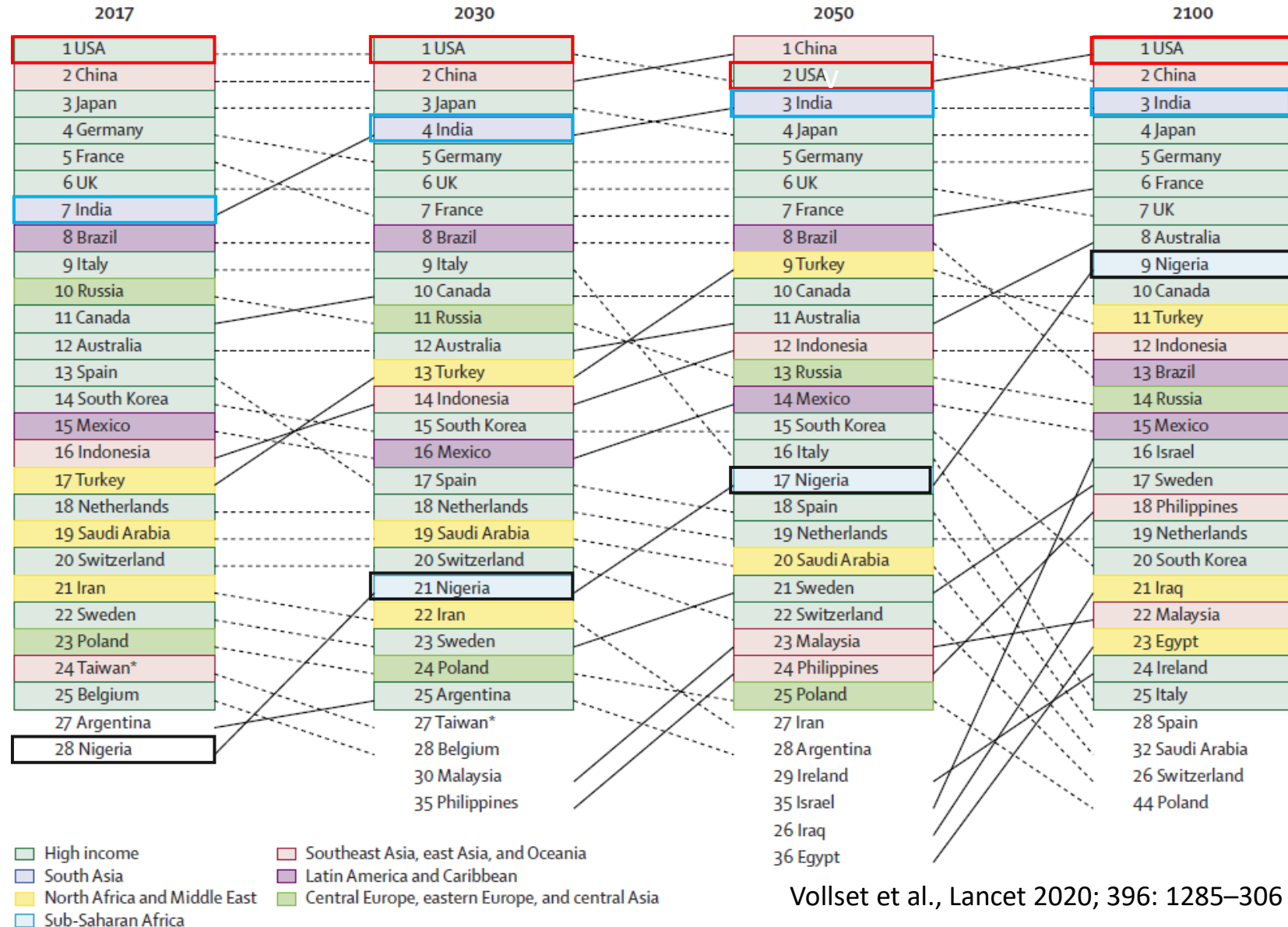
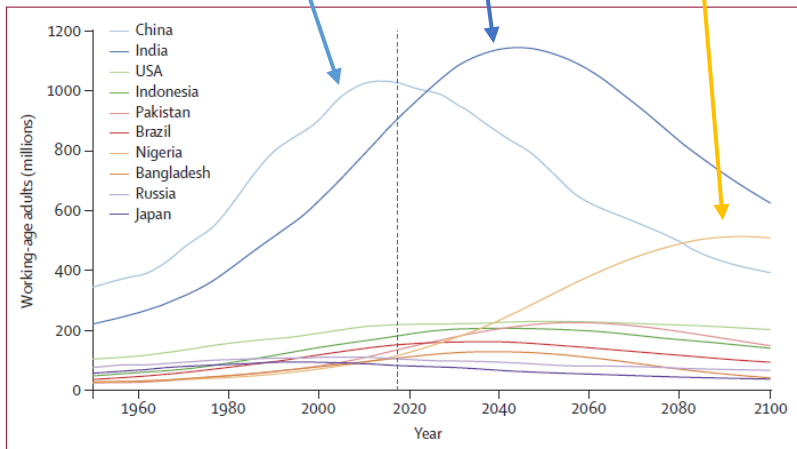
Is Nigeria going to be the next India?

Ranking of the top 25 economies by size

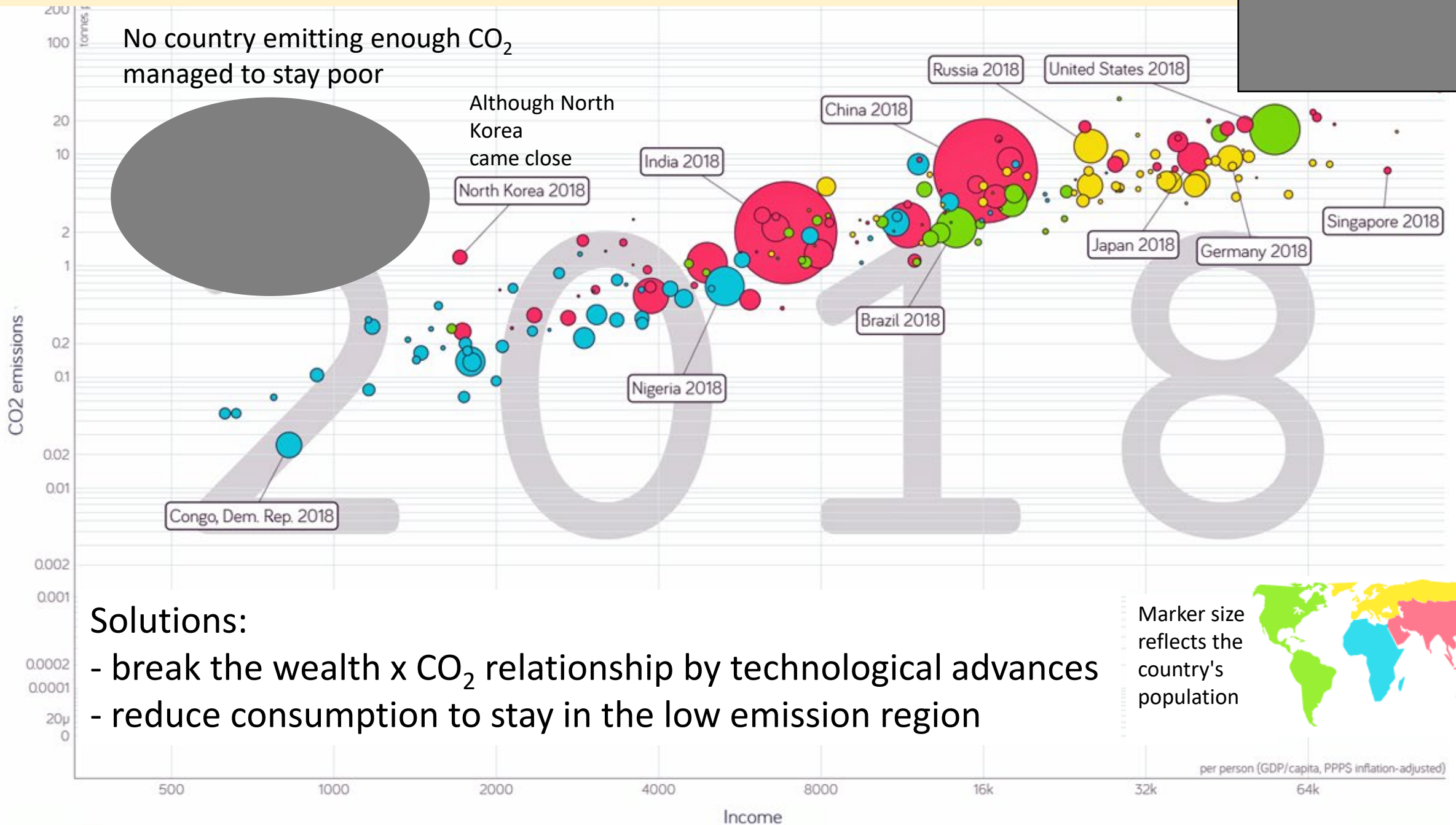


POPULATION 2017 TO 2100

China 2015 India 2045 Nigeria 2100



Bad news: CO₂ emissions remain closely connected with wealth of the nations



Solutions of environmental problems



Techno-optimism

genuine optimism

[technological progress solves more problems than it causes]

we have gone too far to stop playing now

[technological progress offers the only hope of solving the problems we are already facing]

SOLUTION: more technology to increase or maintain consumption

Techno-pessimism

[technological progress is dangerous, causes net increase in problems]

SOLUTION: not more, perhaps even less technology, less consumption

Solutions of environmental problems



This is essentially a Malthusian problem: our population and its needs increase geometrically, technology is a tool for keeping pace with them

Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio.

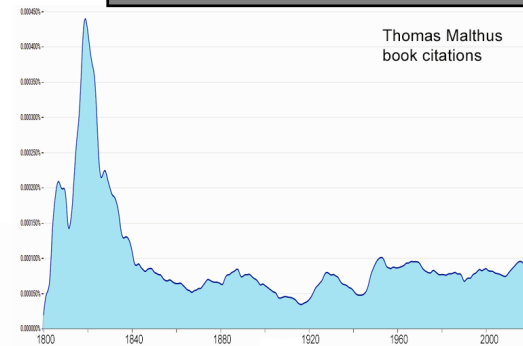
Thomas Malthus (1768-1834)

ESSAY ON THE PRINCIPLE OF POPULATION

Part 1. On the checks to population in the less civilised parts of the world and in past times.

In an inquiry concerning the improvement of society, the mode of conducting the subject that naturally presents itself is —

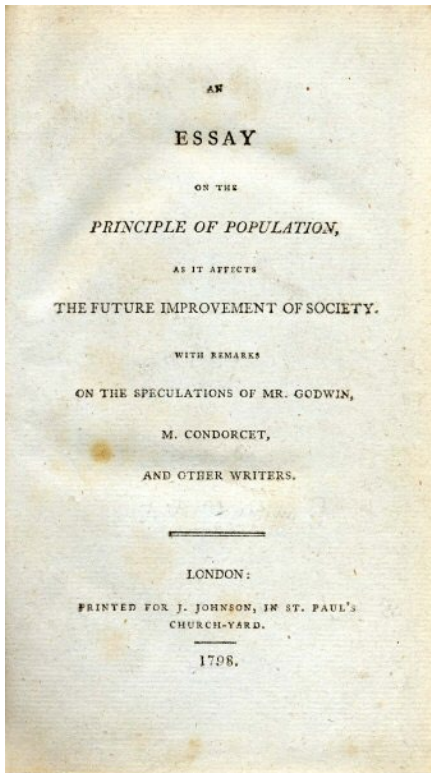
1. To investigate the causes that have hitherto impeded the progress of mankind towards happiness; and
2. To examine the probability of the total or partial removal of these causes in the future.



ESSAY
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PRINCIPLE OF POPULATION.
—
BOOK I.
OF THE CHECKS TO POPULATION IN THE LESS CIVILISED PARTS OF
THE WORLD AND IN PAST TIMES.
—
CHAPTER I.
STATEMENT OF THE SUBJECT. RATIOS OF THE INCREASE OF
POPULATION AND FOOD.

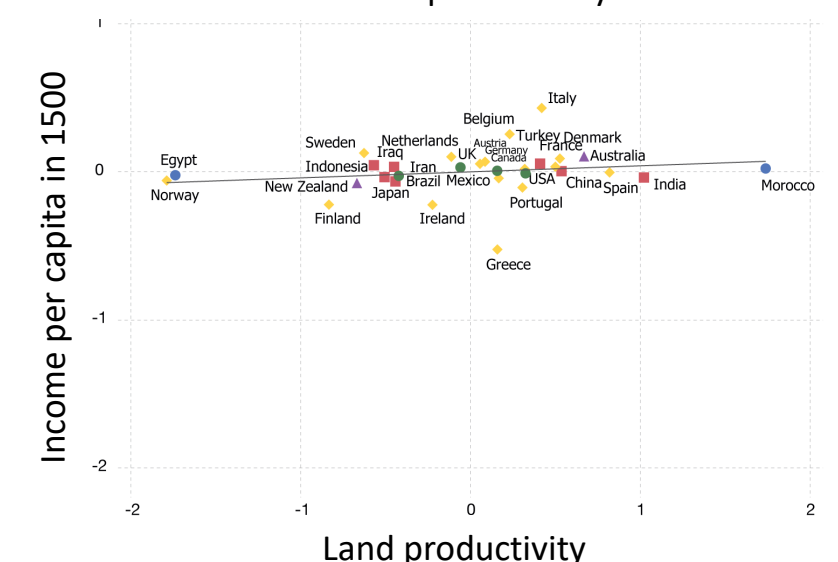
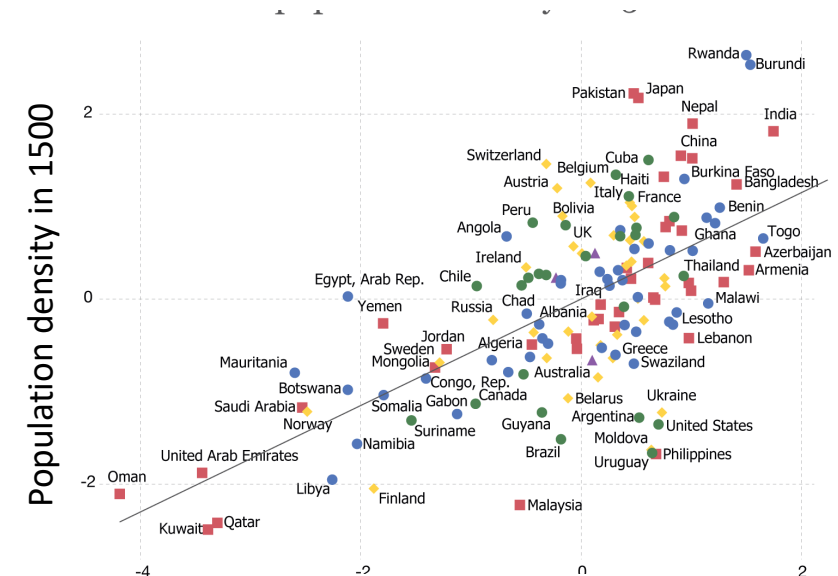
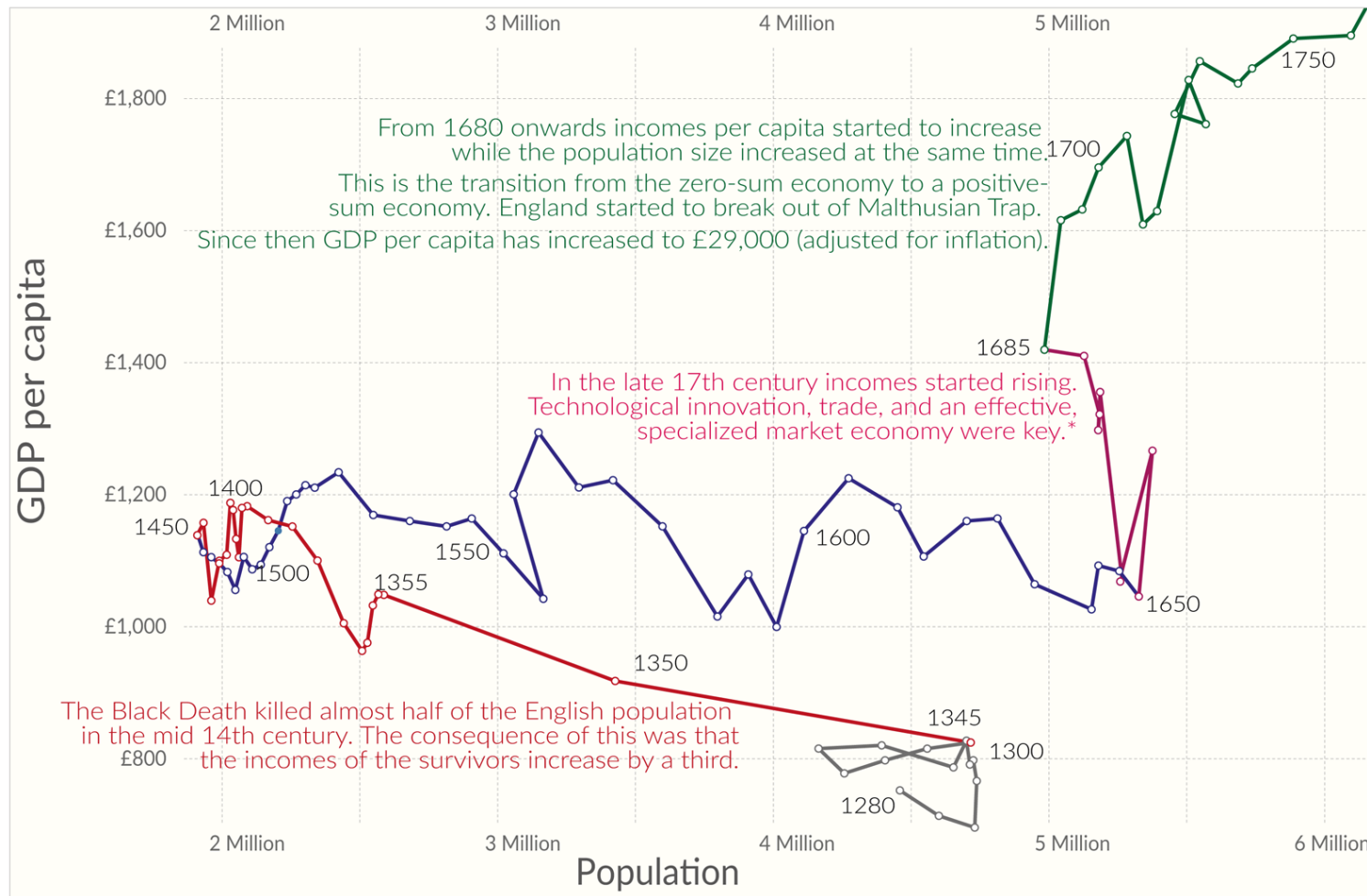
In an inquiry concerning the improvement of society, the mode of conducting the subject which naturally presents itself, is—

1. To investigate the causes that have hitherto impeded the progress of mankind towards happiness; and,
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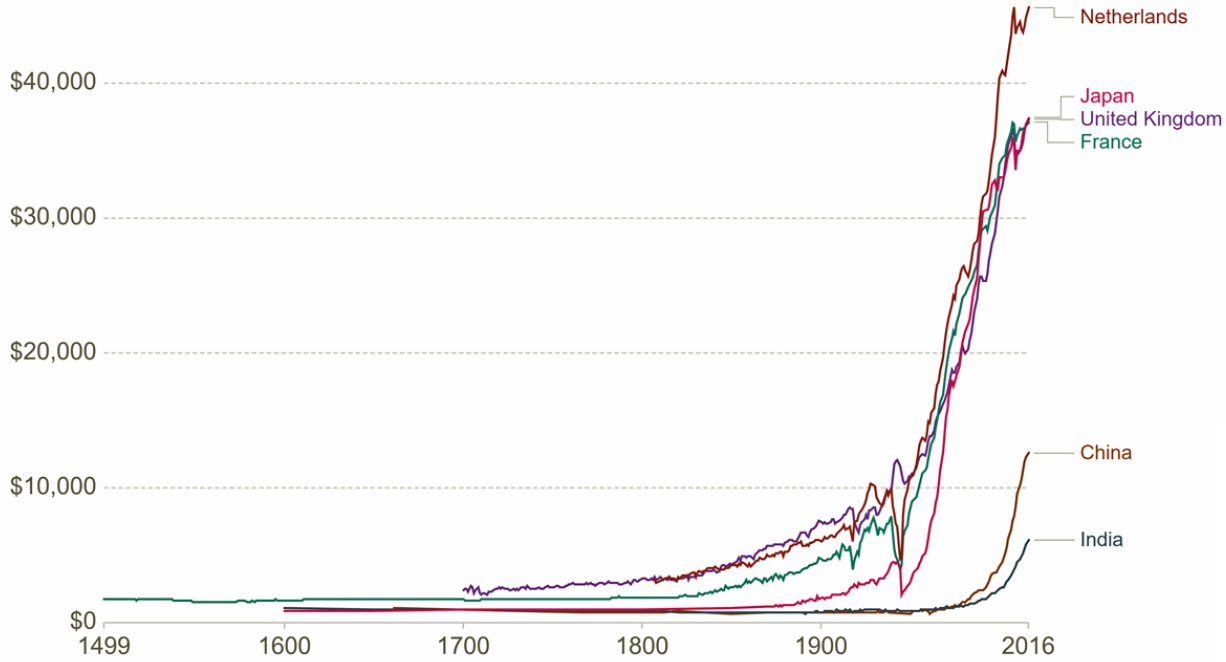


In the “Malthusian economy” before industrial revolution, economy produced additional people, not increased prosperity



GDP per capita, 1499 to 2016

GDP per capita adjusted for price changes over time (inflation) and price differences between countries – it is measured in international-\$ in 2011 prices.



Source: Maddison Project Database (2018)

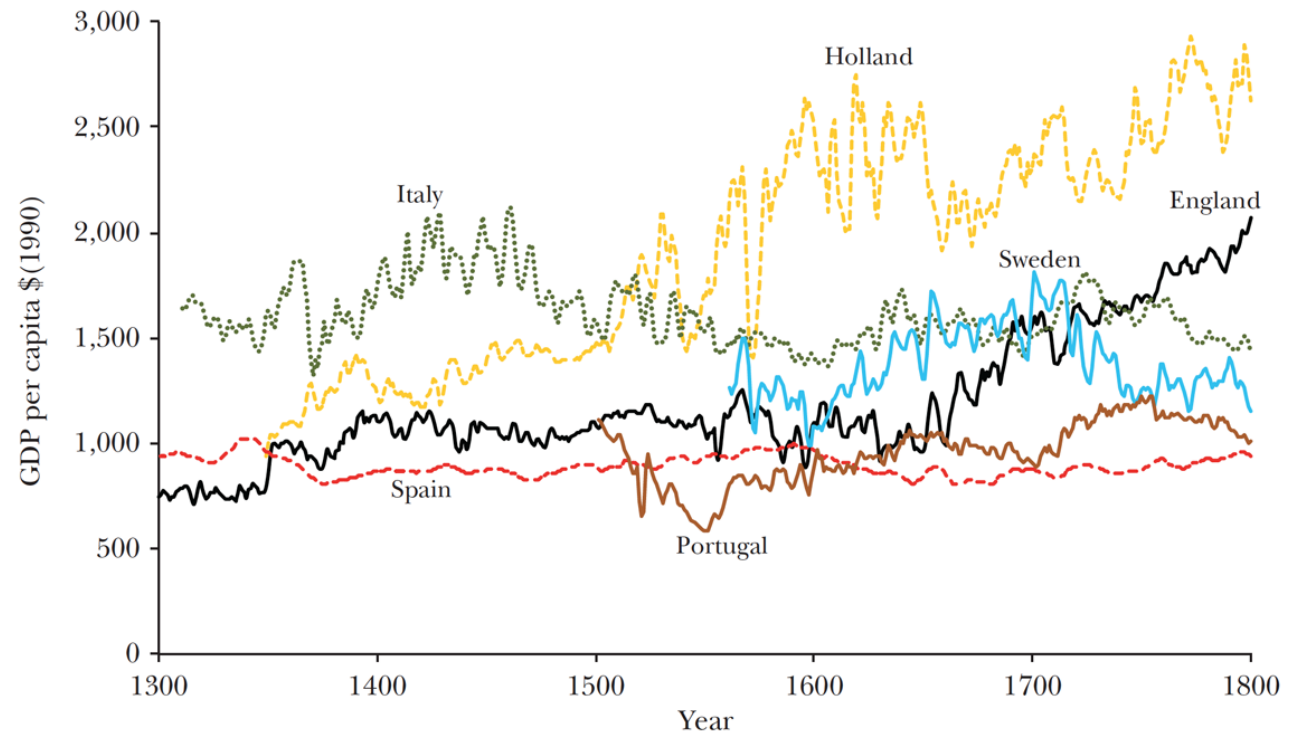
OurWorldInData.org/economic-growth • CC BY

Note: These series are adjusted for price differences between countries based on only a single benchmark year, in 2011. This makes them suitable for studying the growth of incomes over time but not for comparing income levels between countries.

Economic growth is not a constant feature of human history

GDP per Capita in Selected European Economies, 1300–1800

(three-year average; Spain eleven-year average)



Technological progress:

- develops in unpredictable directions
- progress can escalate rapidly
- creates unforeseen problems
- solved only by more technology (or not)

First website 6 Aug 1991

<http://info.cern.ch/hypertext/WWW/TheProject.html>

World Wide Web

The WorldWideWeb (W3) is a wide-area [hypermedia](#) information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an [executive summary](#) of the project, [Mailing lists](#), [Policy](#), November's [W3 news](#), [Frequently Asked Questions](#).

[What's out there?](#)

Pointers to the world's online information, [subjects](#), [W3 servers](#), etc.

[Help](#)

on the browser you are using

[Software Products](#)

A list of W3 project components and their current state. (e.g. [Line Mode](#), [X11 Viola](#), [NeXTStep](#), [Servers](#), [Tools](#), [Mail robot](#), [Library](#))

[Technical](#)

Details of protocols, formats, program internals etc

[Bibliography](#)

Paper documentation on W3 and references.

[People](#)

A list of some people involved in the project.

[History](#)

A summary of the history of the project.

[How can I help?](#)

If you would like to support the web..

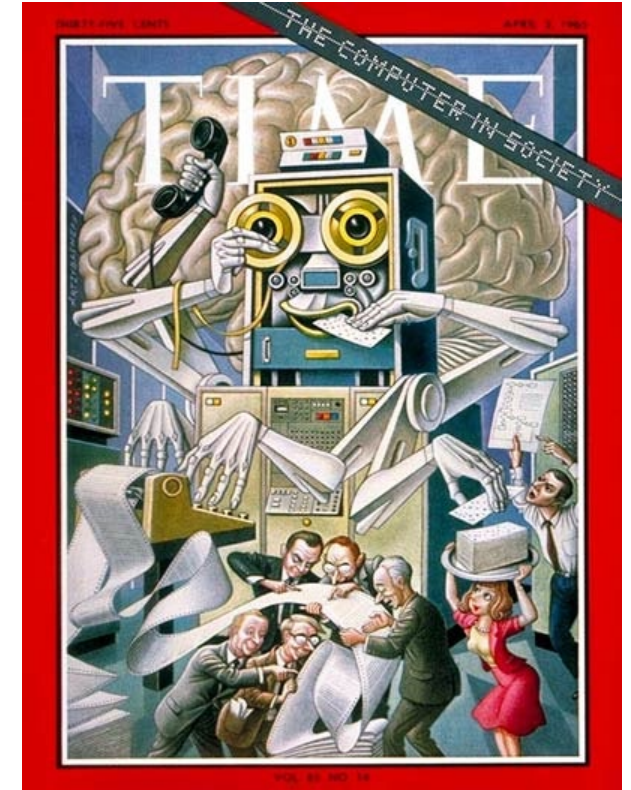
[Getting code](#)

Getting the code by [anonymous FTP](#), etc.

Everybody predicted flying cars



Nobody predicted the internet



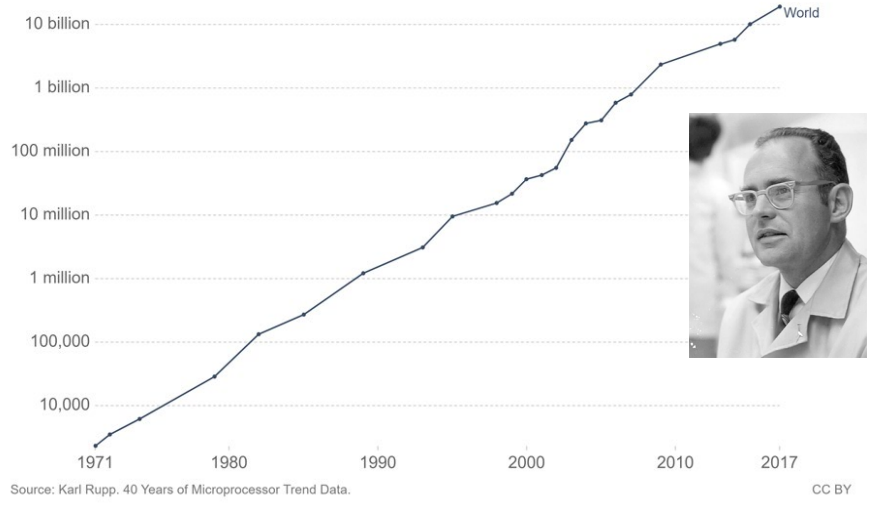
TIME cover in 1965

Tim Berners-Lee
invented World Wide Web in 1991

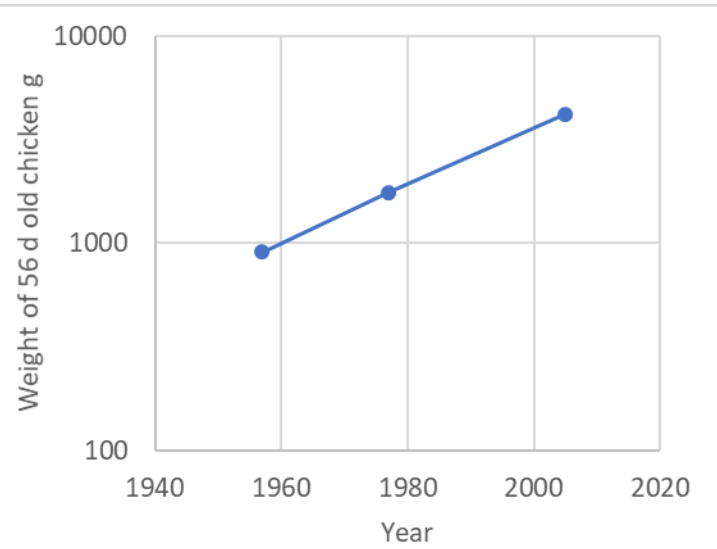
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Gordon Moore (founder of INTEL) in 1975 no of transistors in a chip will double every 2 years

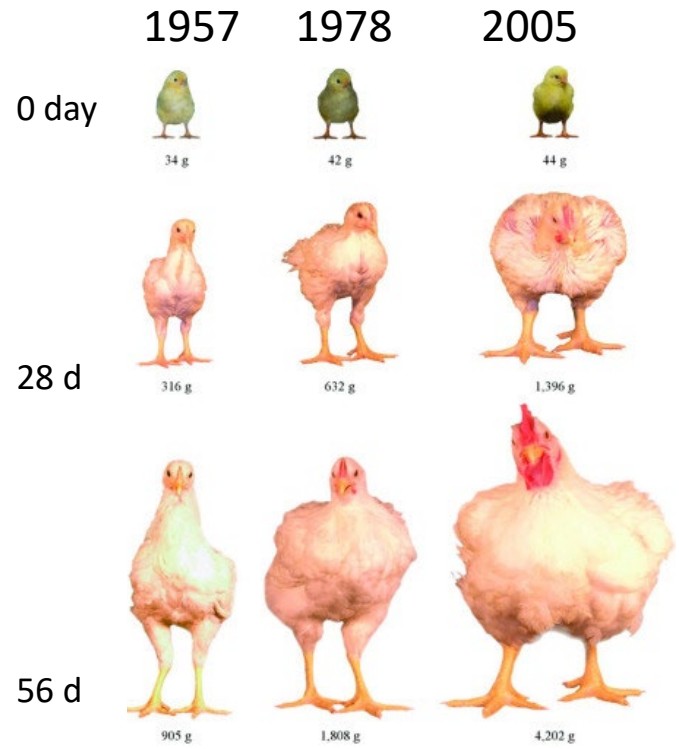


Even chickens follow Moore's law



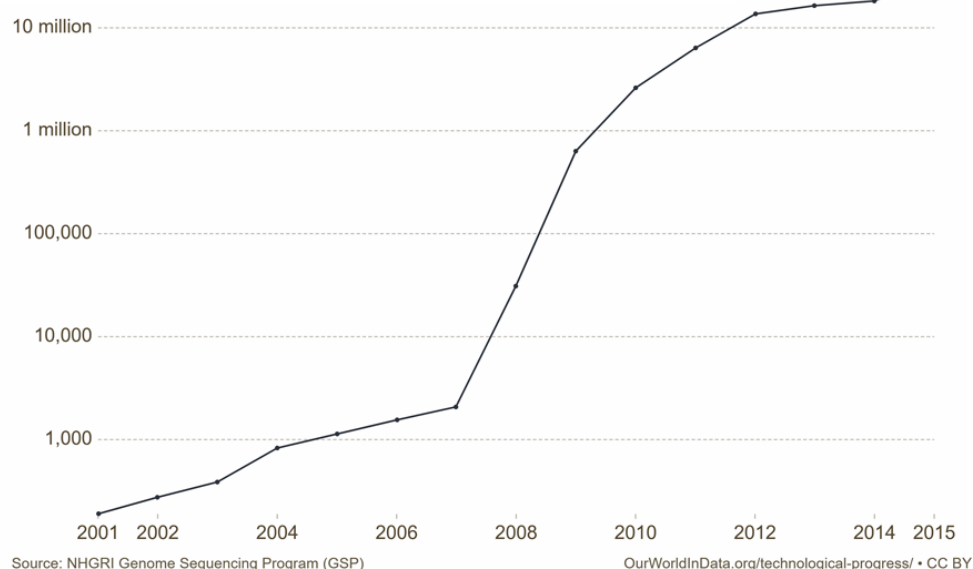
The weight of 56 days old chicken doubles every 20 years

Zuidhof et al. 2014, Poultry Science 93, 2014, 2970-2982



IBM 5MB hard disk in 1956

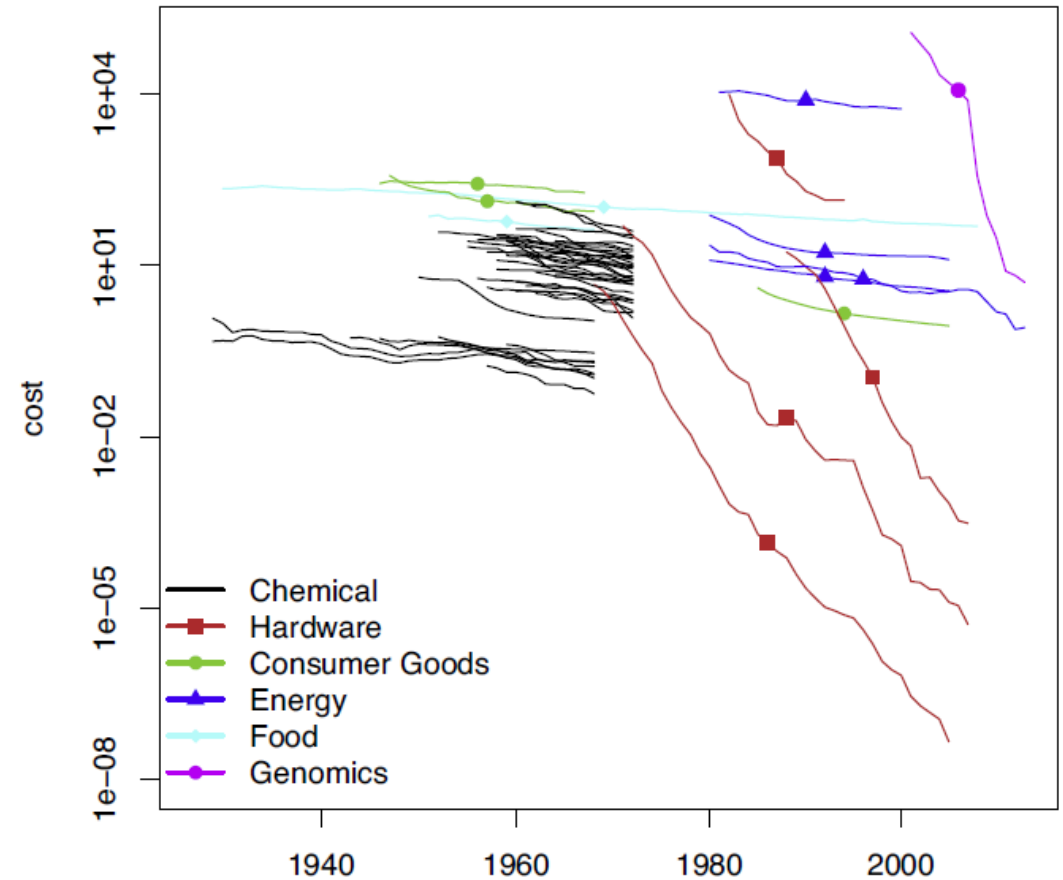
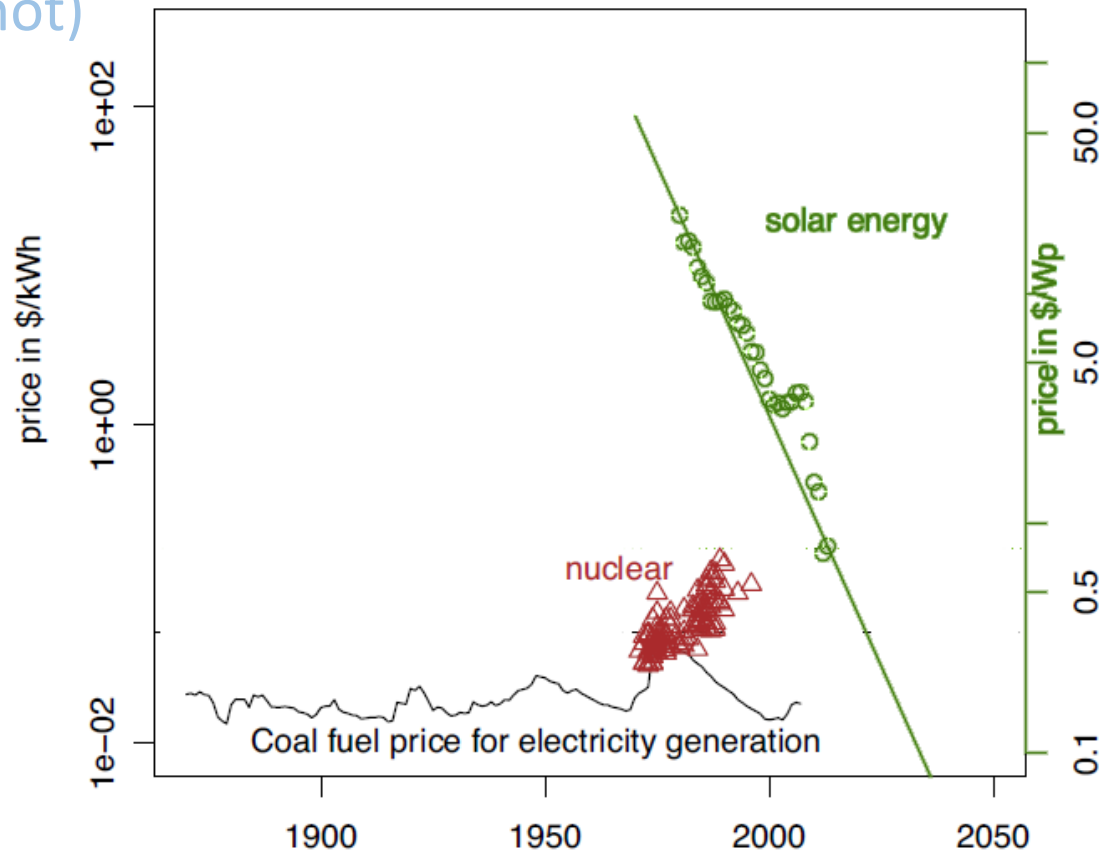
Genome sequencing started as Moore's function then out-performed it



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Many technologies exhibit exponential decrease in costs or increase in performance

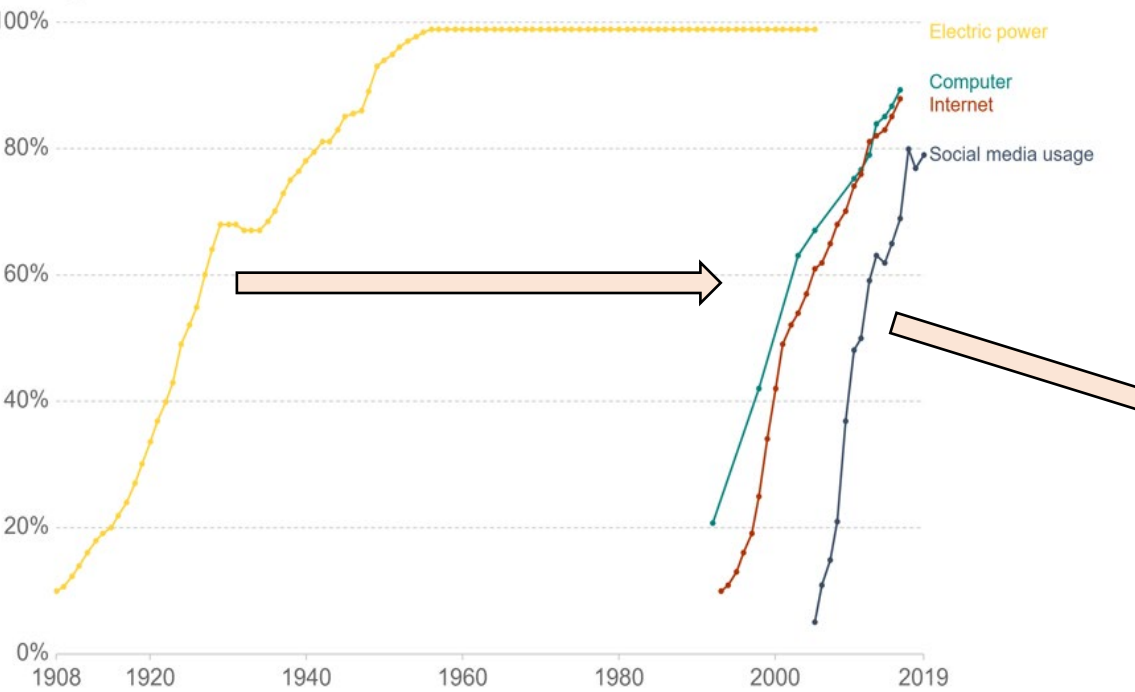


Technological progress:

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Technology adoption in US households, 1908 to 2019

Technology adoption rates, measured as the percentage of households in the United States using a particular technology.

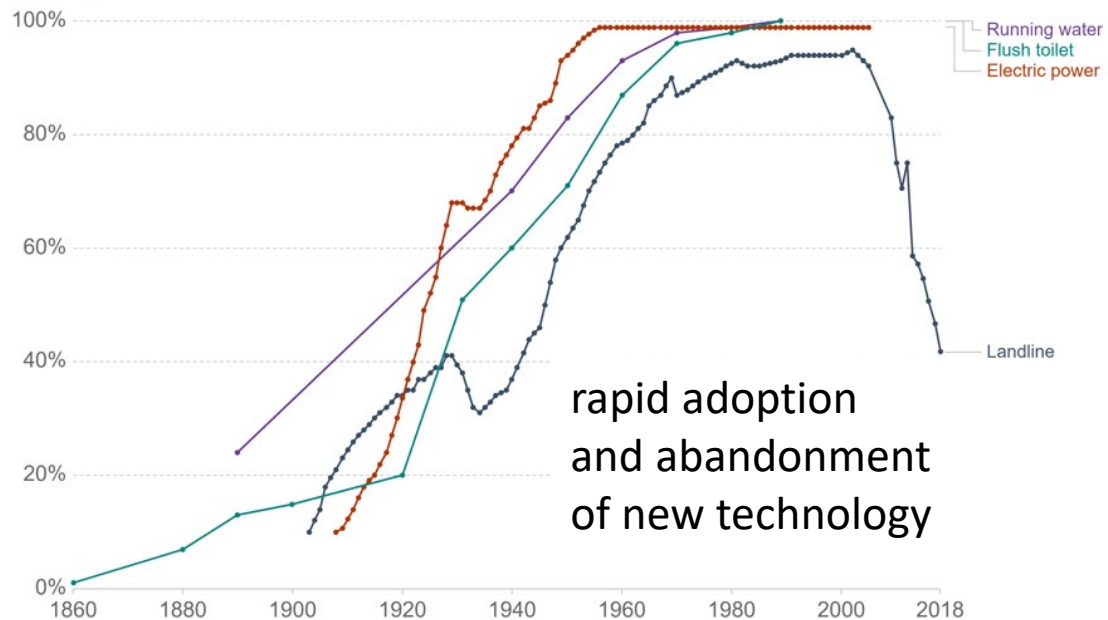


Our World in Data

Source: Comin and Hobijn (2004) and others
 OurWorldInData.org/technology-adoption/ • CC BY
 Note: See the sources tab for definitions of household adoption, or adoption rates, by technology type.

Technology adoption in US households, 1860 to 2018

Technology adoption rates, measured as the percentage of households in the United States using a particular technology.



rapid adoption and abandonment of new technology

Source: Comin and Hobijn (2004) and others
 OurWorldInData.org/technology-adoption/ • CC BY
 Note: See the sources tab for definitions of household adoption, or adoption rates, by technology type.



electricity brought us social bubbles in only 100 years

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5th Ave, New York, 1900

New York 1900

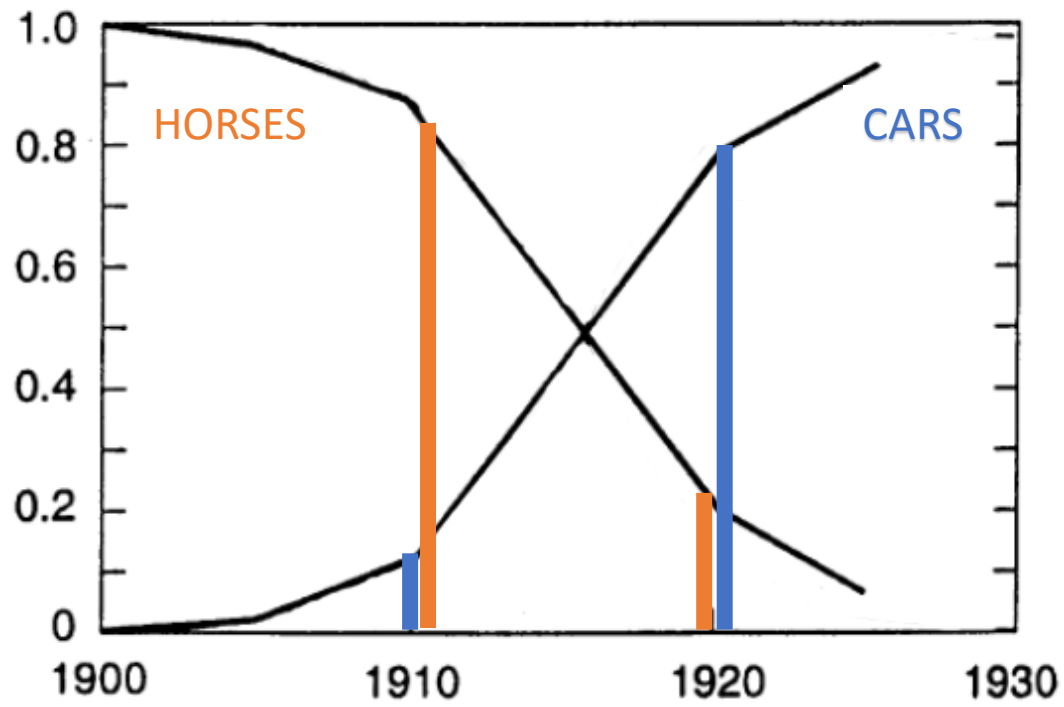
170,000 horses 2000 tons of manure per day

In 50 years, every street will be buried under nine feet of manure

Automobiles as a solution to an ecological crisis



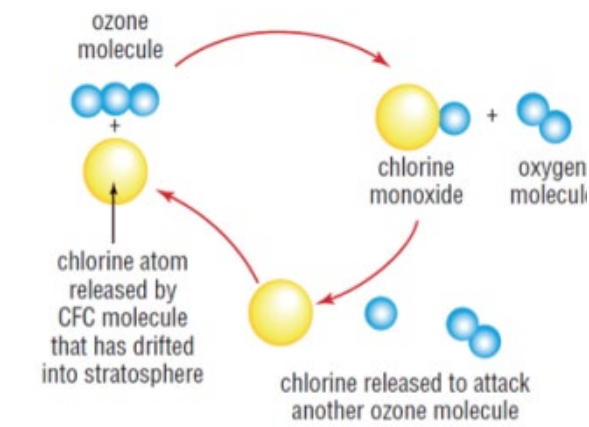
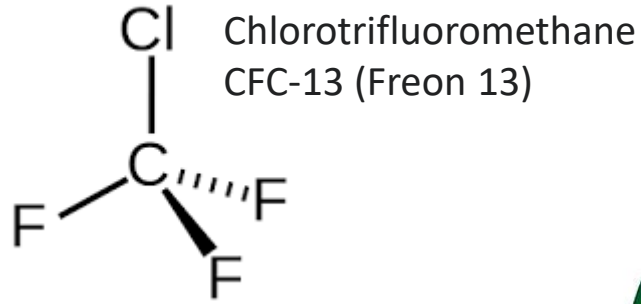
Share of horses and cars on transport in USA



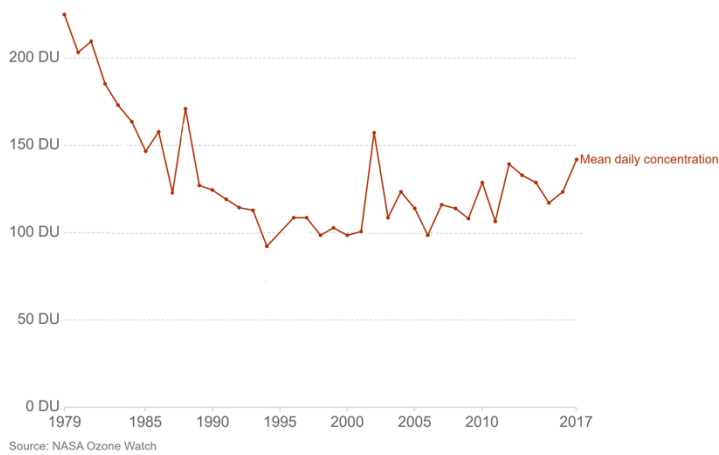
Transition from 80% horses and 20% cars to 20% horses and 80% cars took only 10 years in the USA

Technological progress:

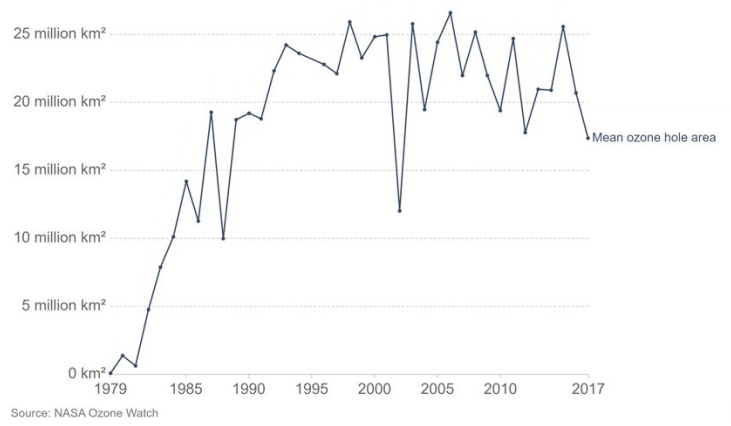
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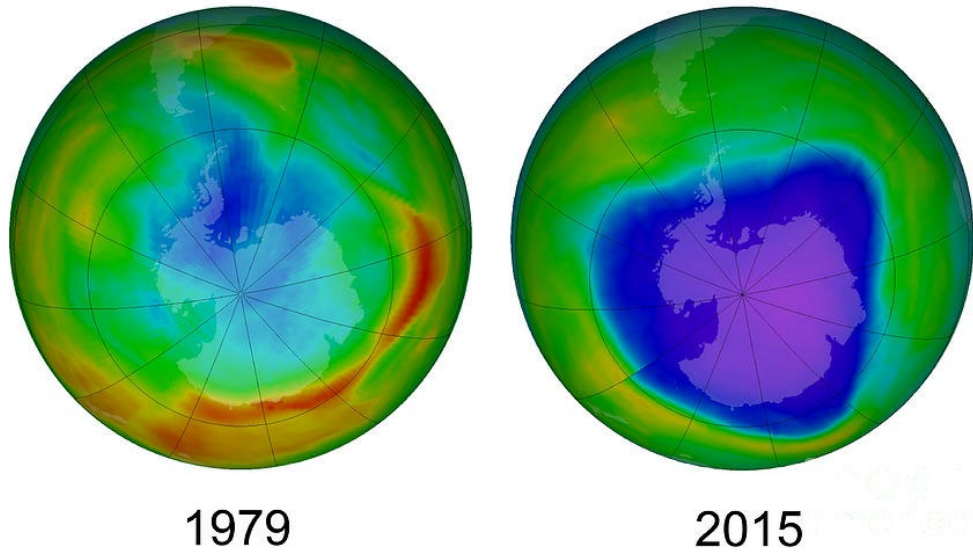
Stratospheric ozone concentration 1979 - 2017



Antarctic ozone hole area 1979 - 2017

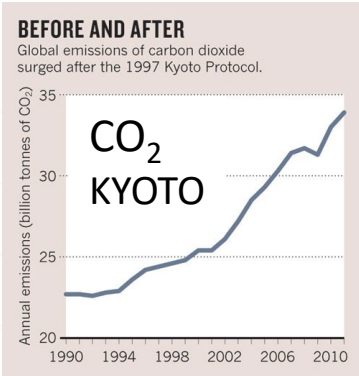
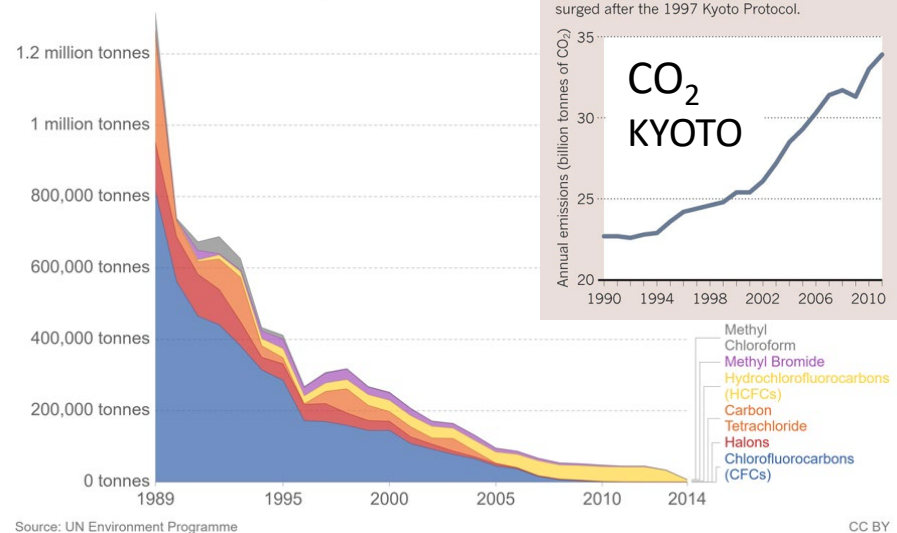


Ozone hole problem



Antarctic Ozone Hole, 1979 And 2015 by Jessica Wilson/NASA

Global ozone-depleting substances consumption 1989 - 2014

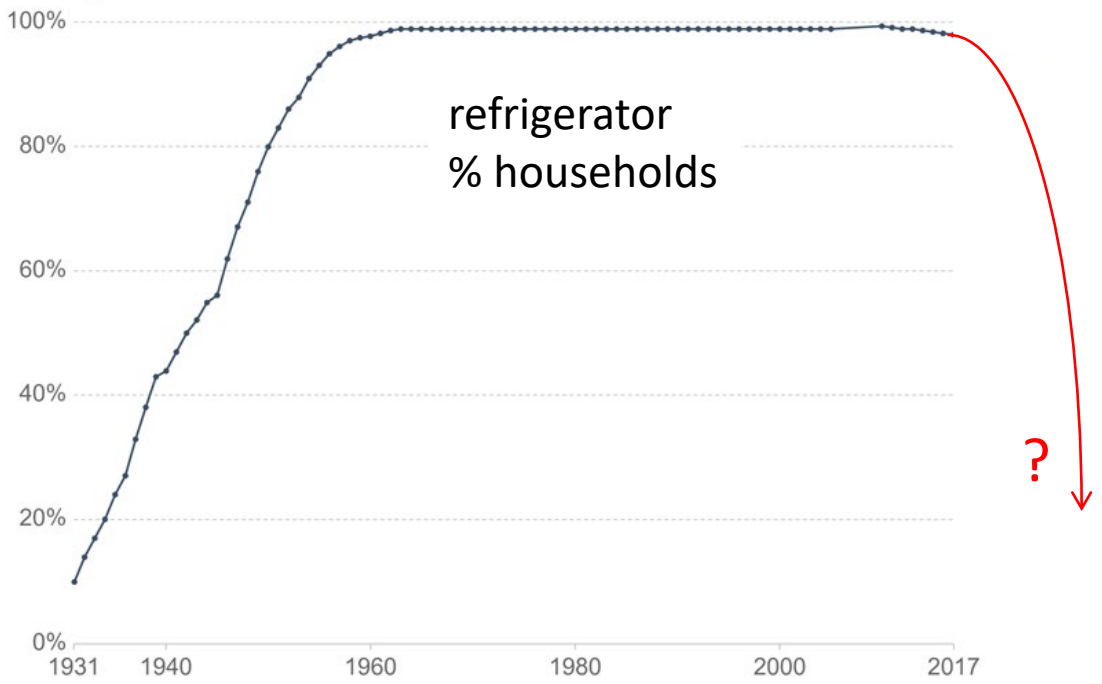


Technological progress:

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(or not)

Technology adoption in US households, 1931 to 2017
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Ozone hole:

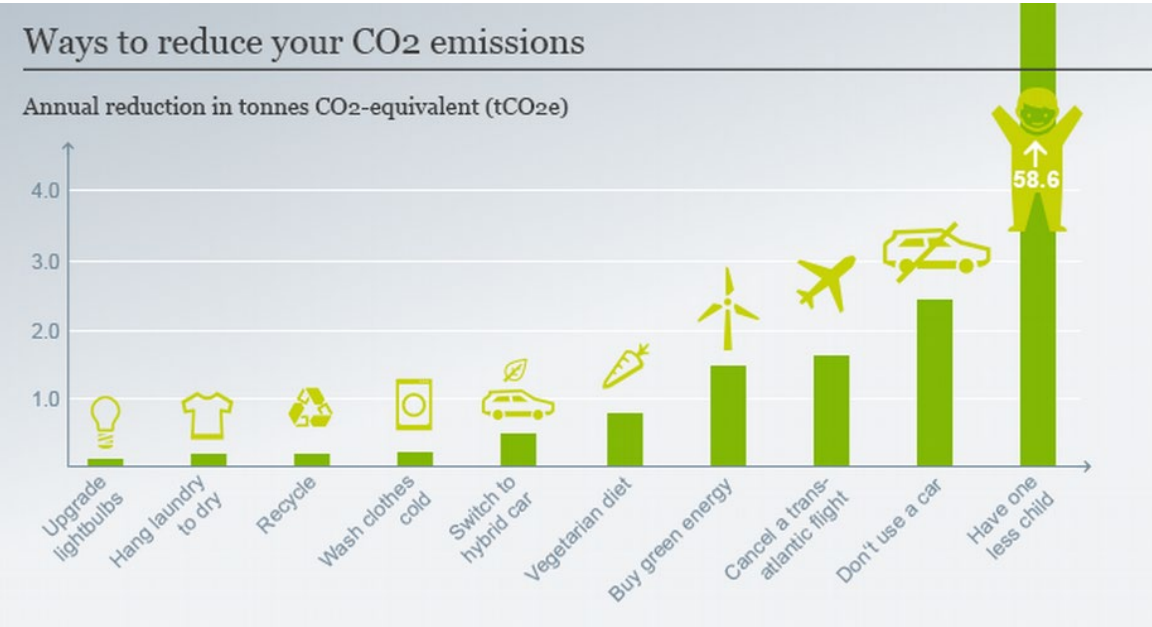
Techno-pessimistic solution

save the planet, stop refrigeration!!



kylningskam = guilt from using a fridge
luftkonditioneringskam = shame from air conditioning

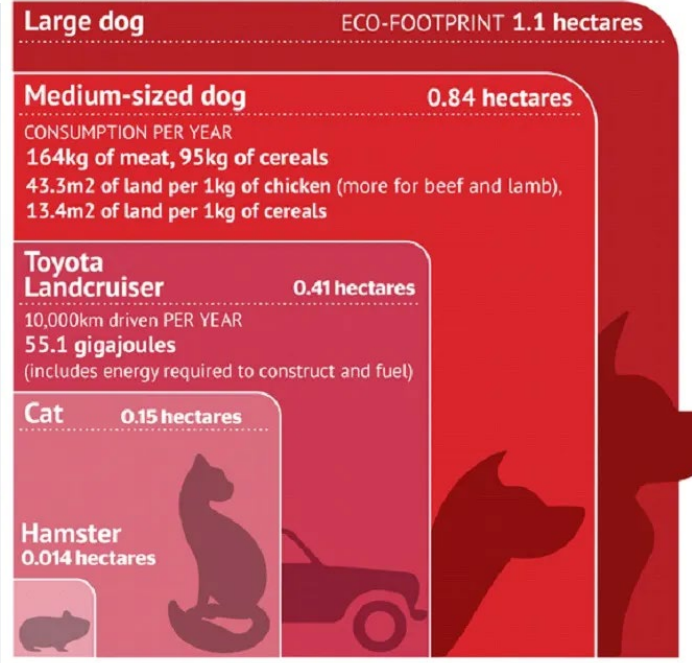
In a carbon-based economy, you are (more or less) guilty whatever you do



The best way to reduce CO₂ footprint is to have fewer children

Even googling stuff on the internet...

CO₂-gle™



SOURCE: NEW SCIENTIST MAGAZINE, 24/10/2009, "HOW GREEN IS YOUR PET," EVALUATED CLAIMS FROM THE BOOK, TIME TO EAT THE DOG: THE REAL GUIDE TO SUSTAINABLE LIVING.



Work is ruining the world

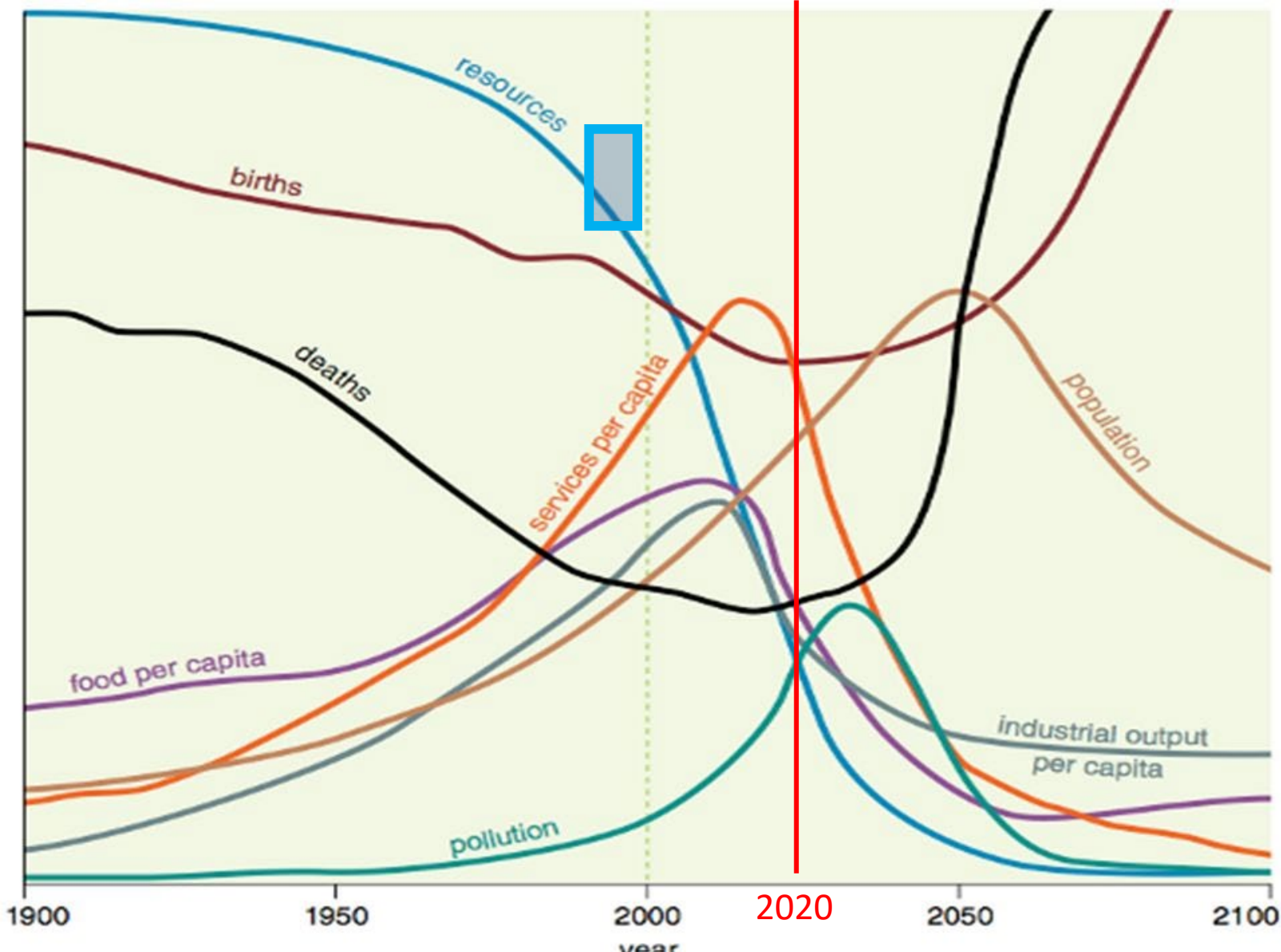
Not only your children, but your dog is also bad for you



Do you want to spend money in a CO₂-free way? Buy a painting!

Jean-Michel Basquiat:
 Untitled, 1982
 sold for \$100.5 million in 2017
 (previously for \$19,000 in 1984)

"Club of Rome" modeled the future of civilization in 1968, predicted increasing scarcity of non-renewable materials (oil, metals, etc.) followed by a collapse of industrial production (~2070), agriculture and finally human population size



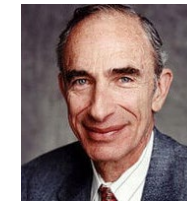
Anyone who believes that exponential growth can go on forever in a finite world is either a madman or an economist.

K. Boulding 1973



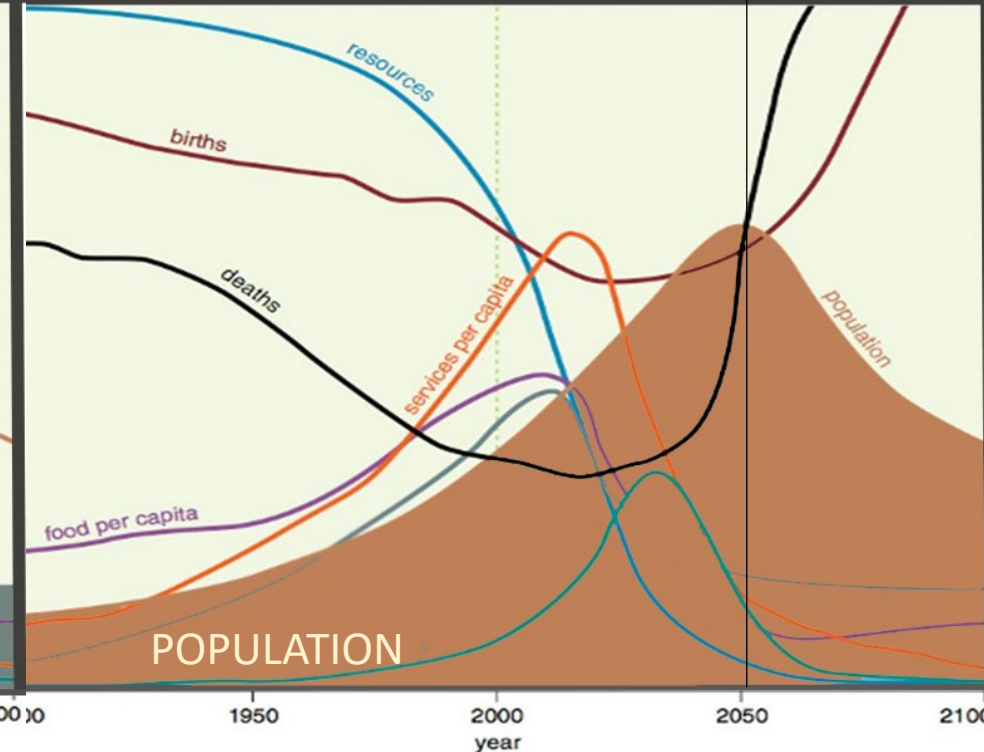
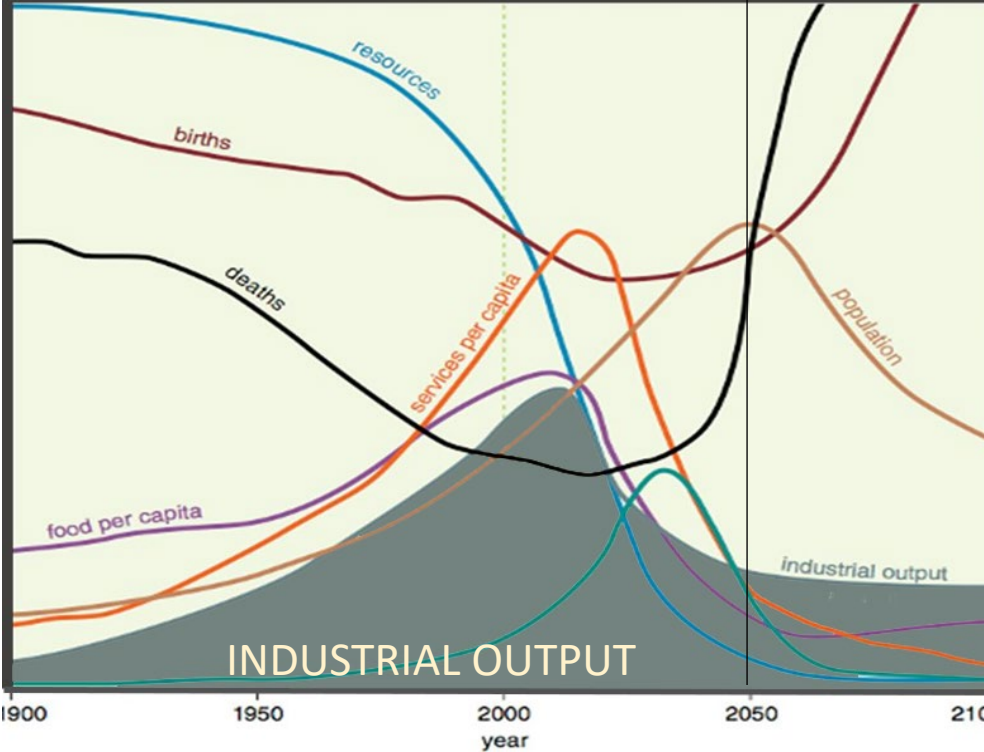
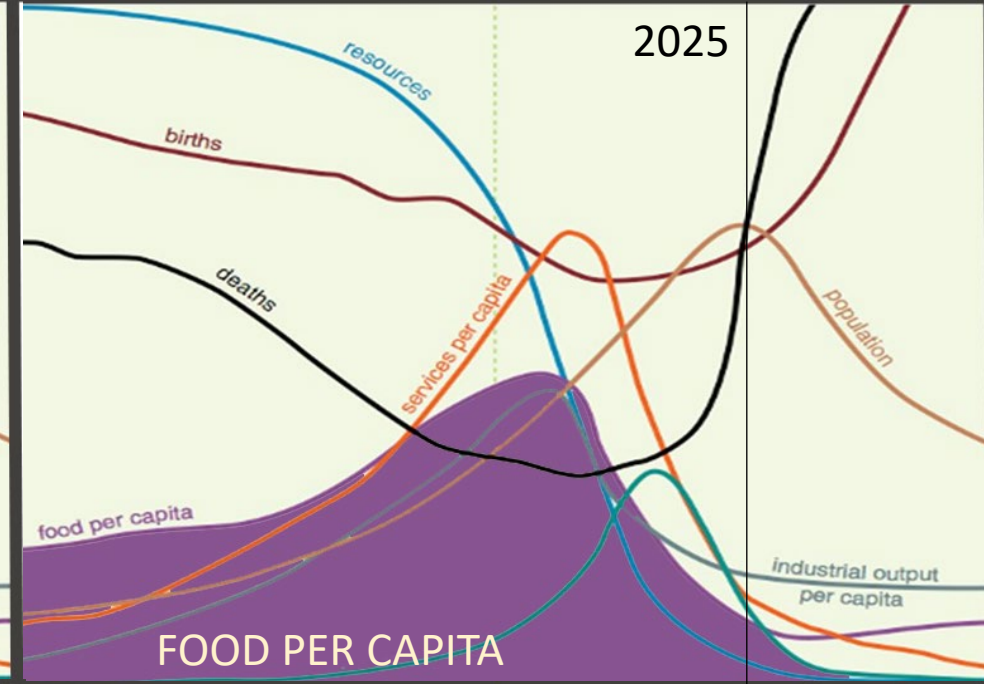
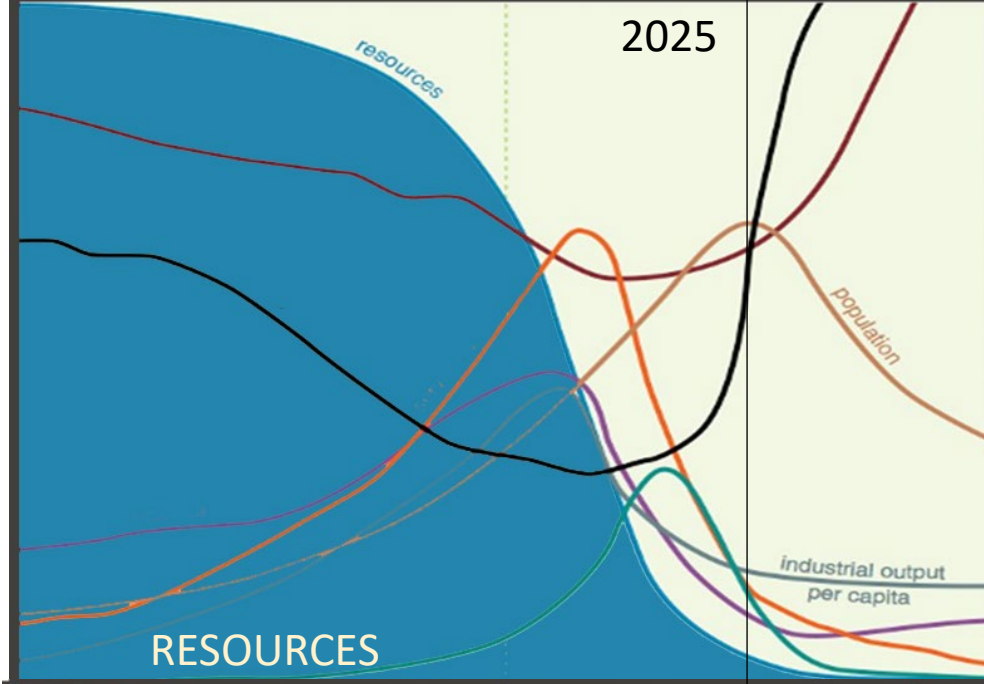
together with the good old T. Malthus again

Julian Simon – Paul Ehrlich \$10,000 wager:

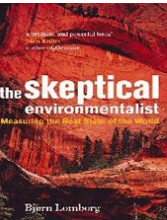
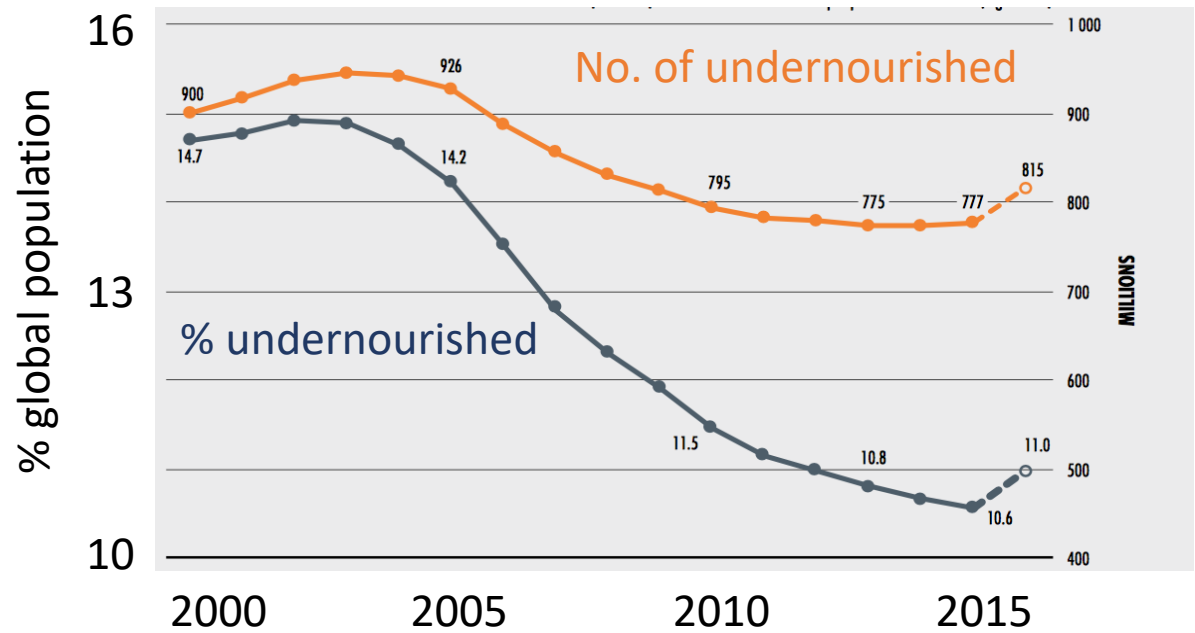
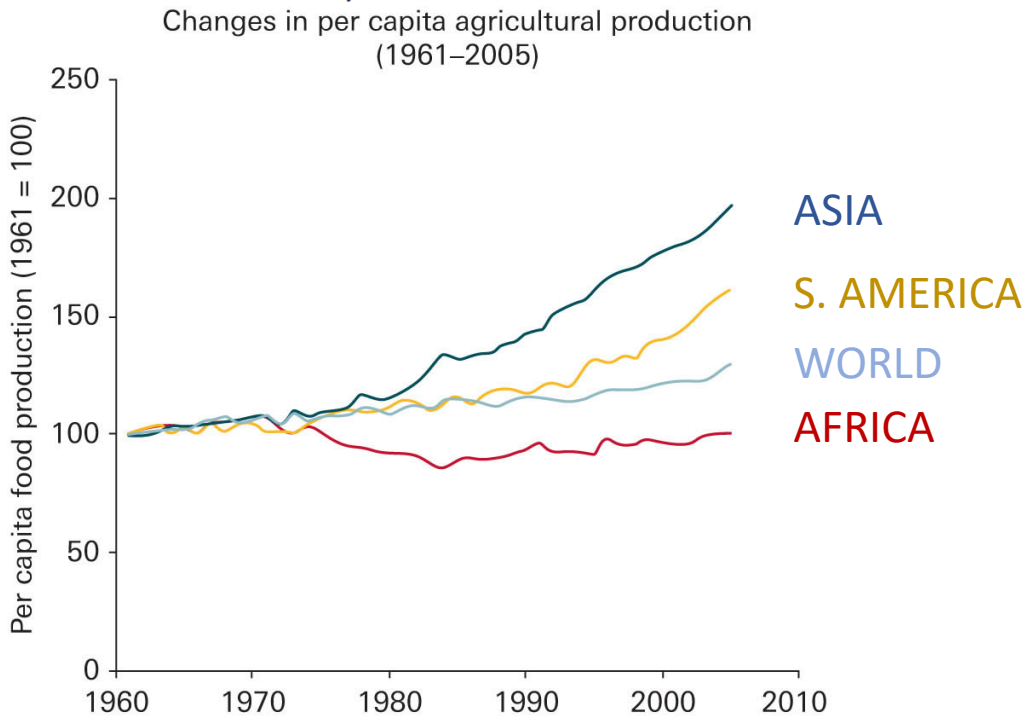
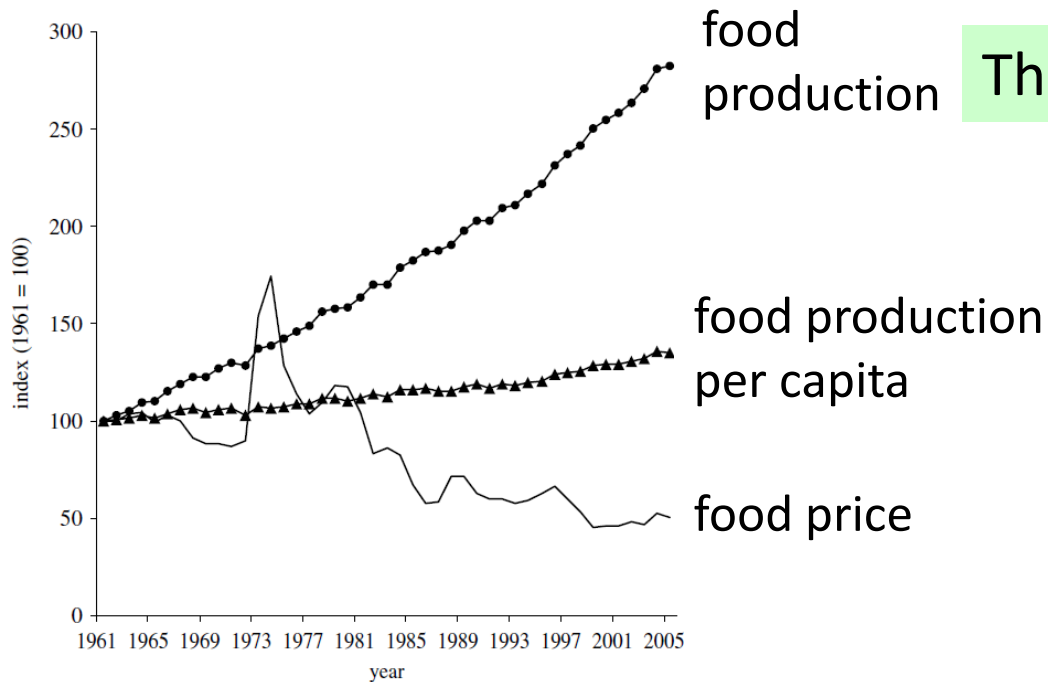


Simon challenged Ehrlich that market price of resources will go down over 10 years, 1980-1990 (as opposed to the Club of Rome model)

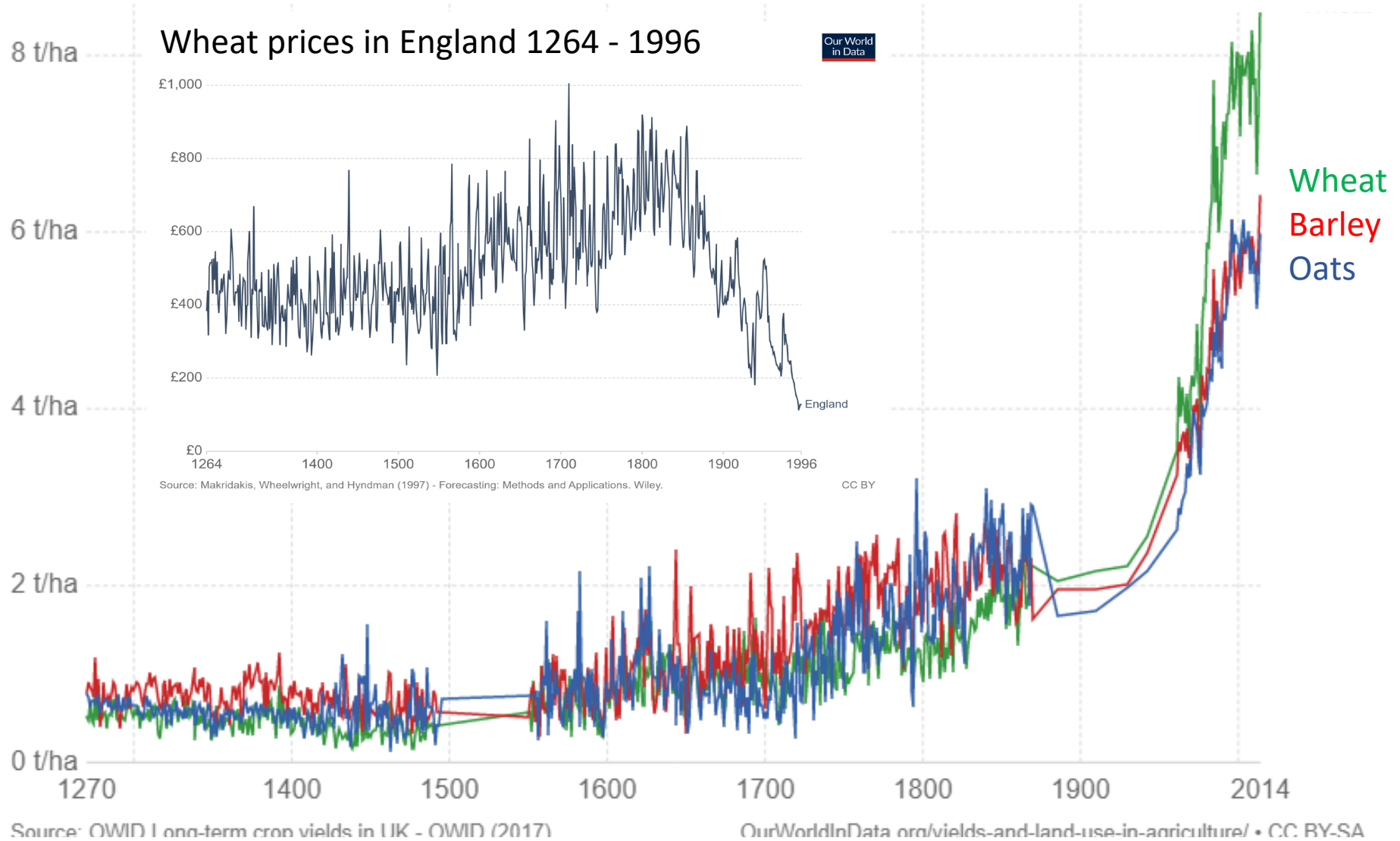
Ehrlich picked copper, chromium, nickel, tin and tungsten; he lost for all of them

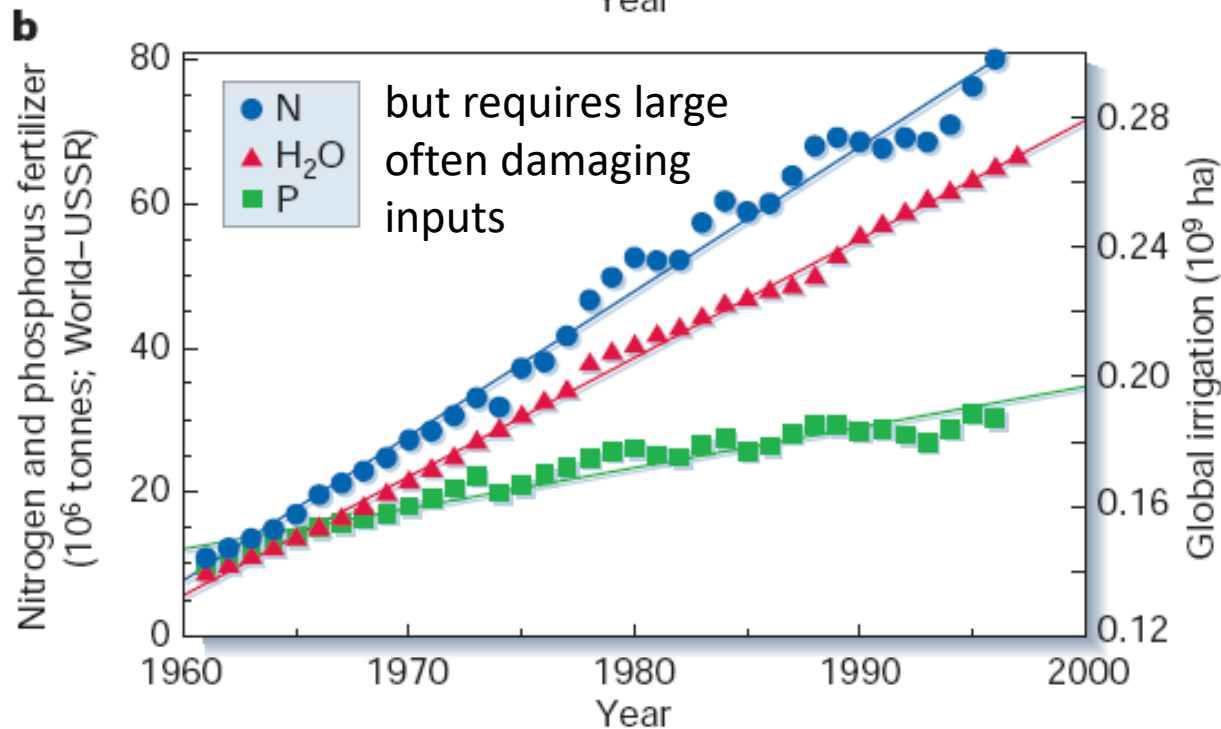
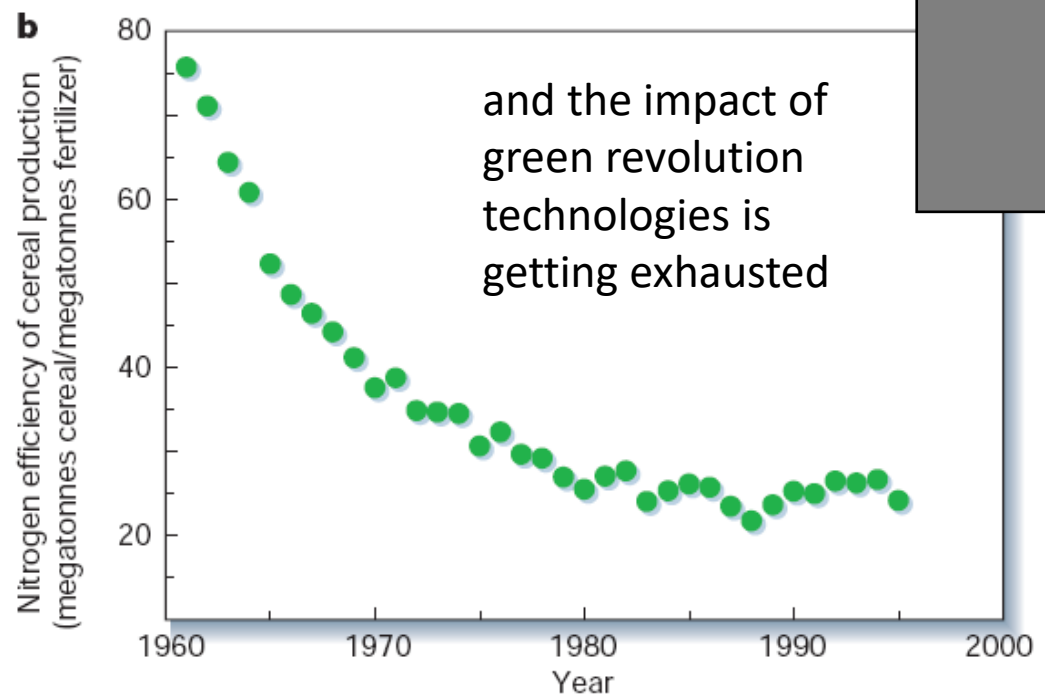
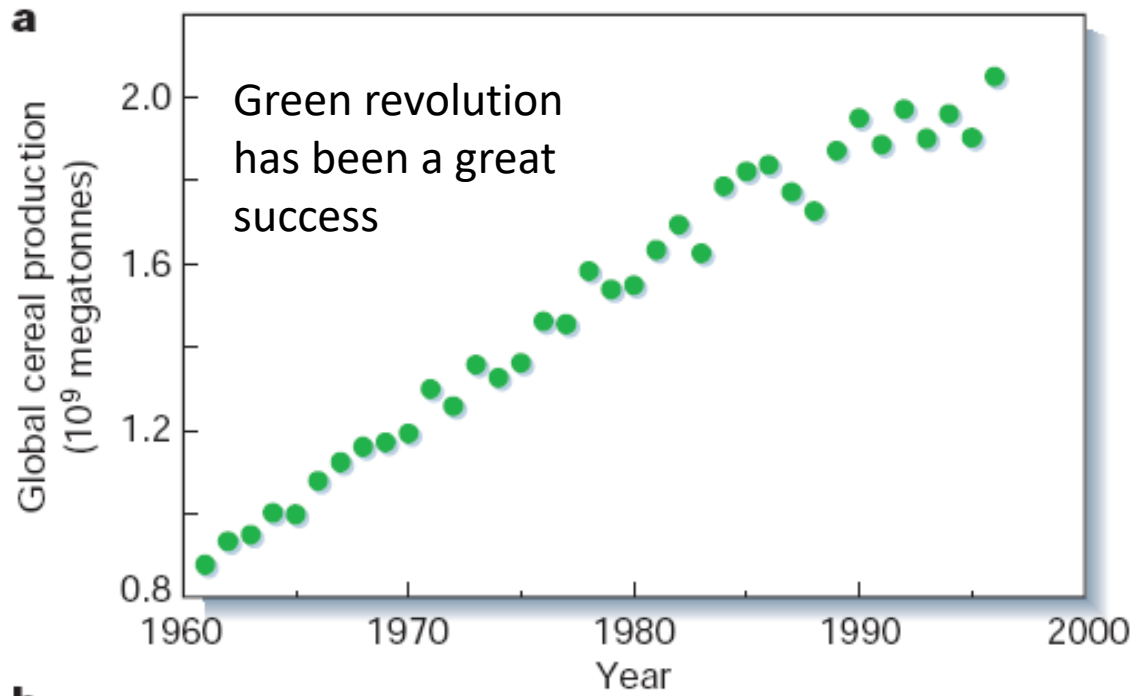


The reality has not been so disastrous...



It is easy to underestimate the power of technology: yields of grains in England 1270 - 2014





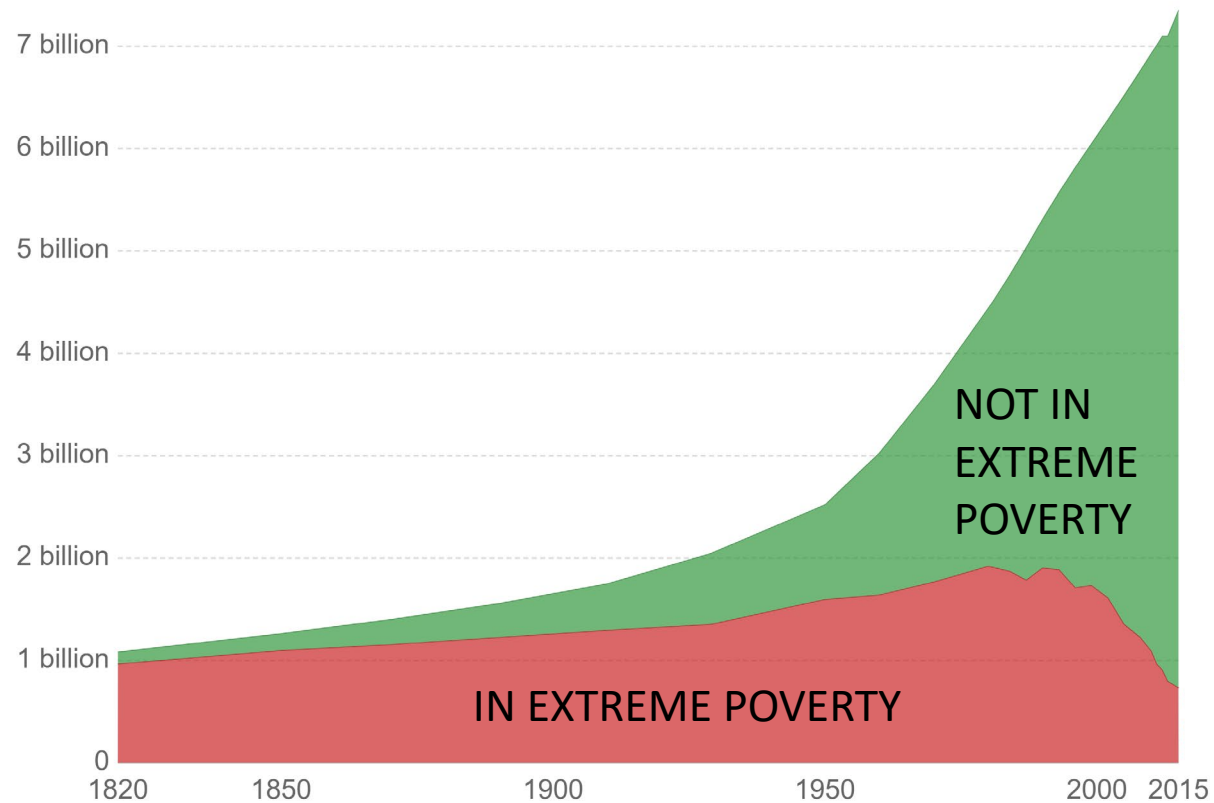
Green revolution: what next?



Last 30 years has been the time of economic miracle: the highest number of people in history lifted from extreme poverty

World population living in extreme poverty, 1820-2015

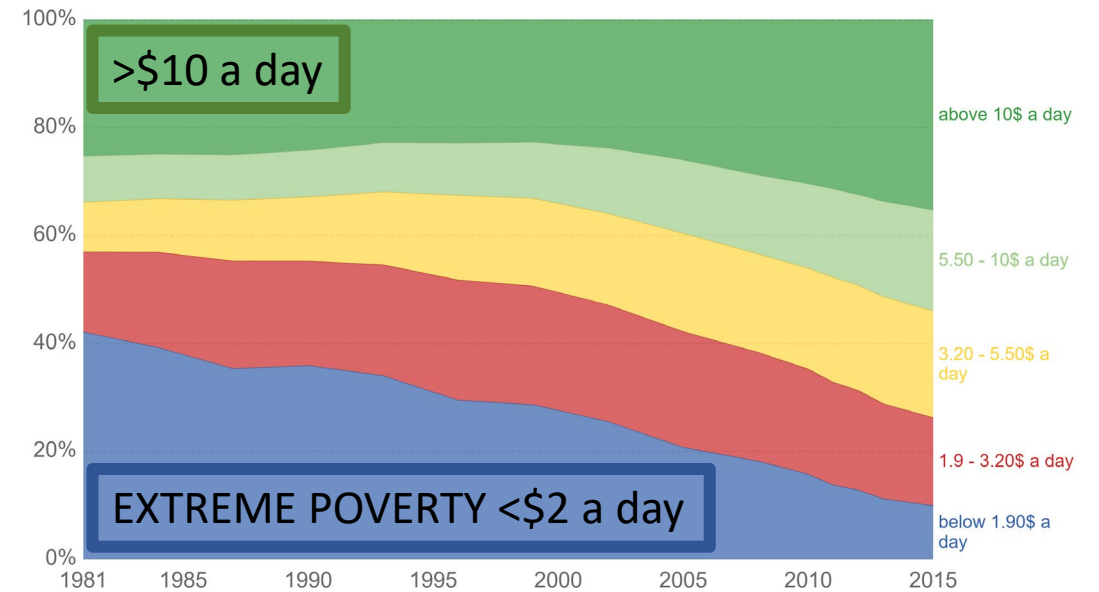
Extreme poverty is defined as living on less than 1.90 international-\$ per day. International-\$ are adjusted for price differences between countries and for price changes over time (inflation).



Our World
in Data

Distribution of population among income levels 1981 - 2015

Our World
in Data



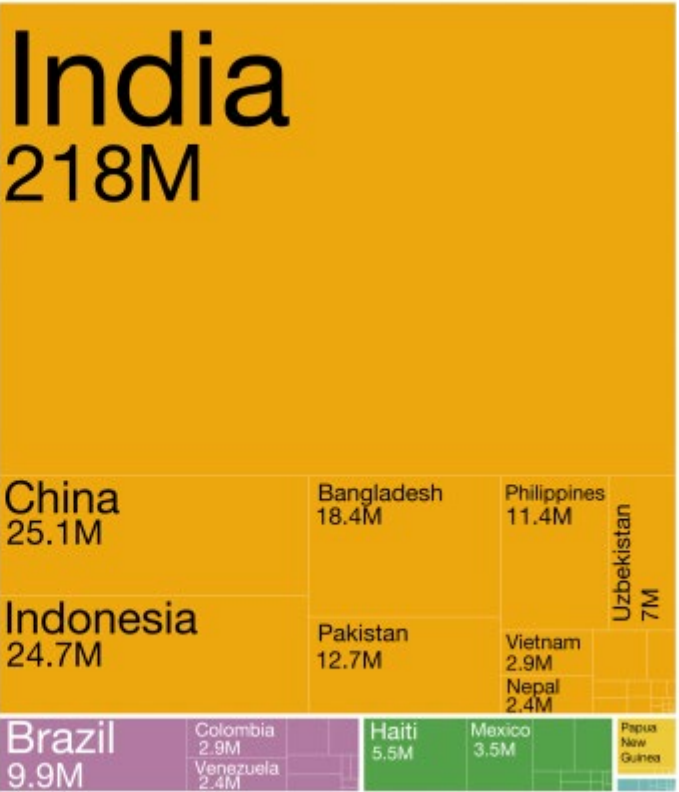
Number of people living extreme in poverty (2013)

This is measured in international dollars (i.e. price differences between countries are taken into account).

Africa (383 million)



Asia (327 million)



South America (19M)



North America (13M)



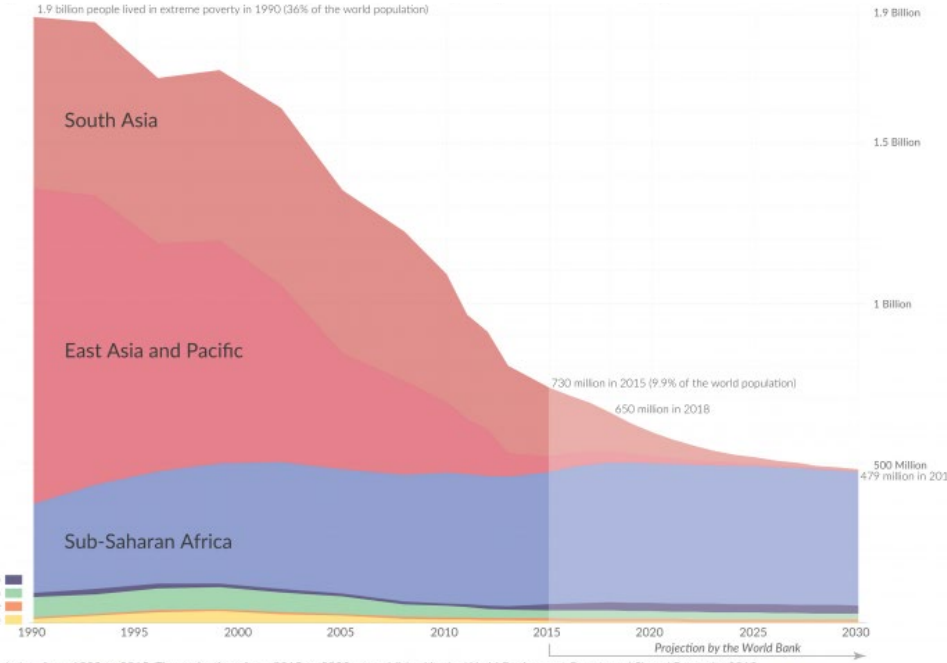
Europe (0.7M)



Oceania (2.5 M)



Number of people in extreme poverty: in 2030 almost exclusively in Africa

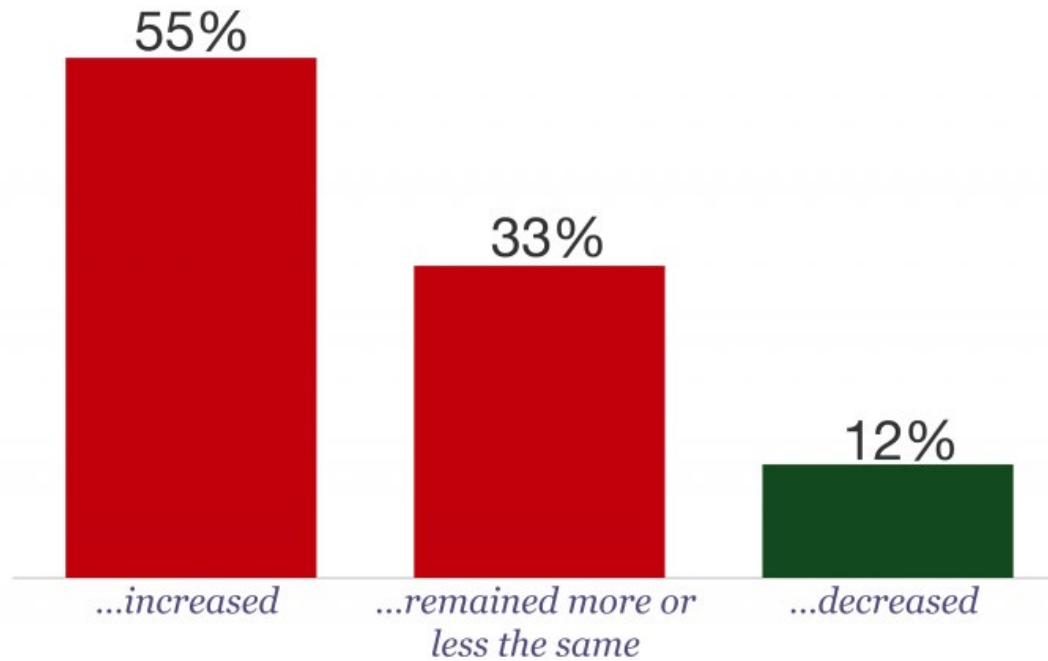


The near-future trends in climate change depend on when and how the 218M Indians get out of extreme poverty (assuming that the Nigerians and Congolese will likely stay poor for a while – although not indefinitely)

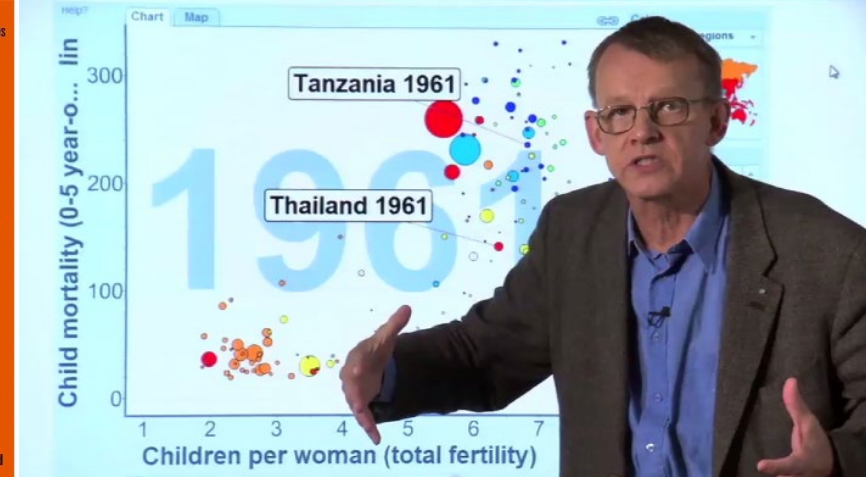
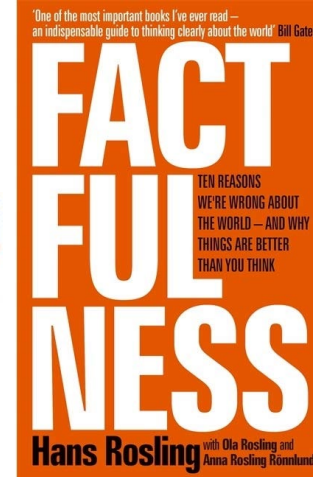
The Hans Rosling's chimp paradox

Great Britain population with a university degree

“In the last 30 years the proportion of the world population living in extreme poverty has...”

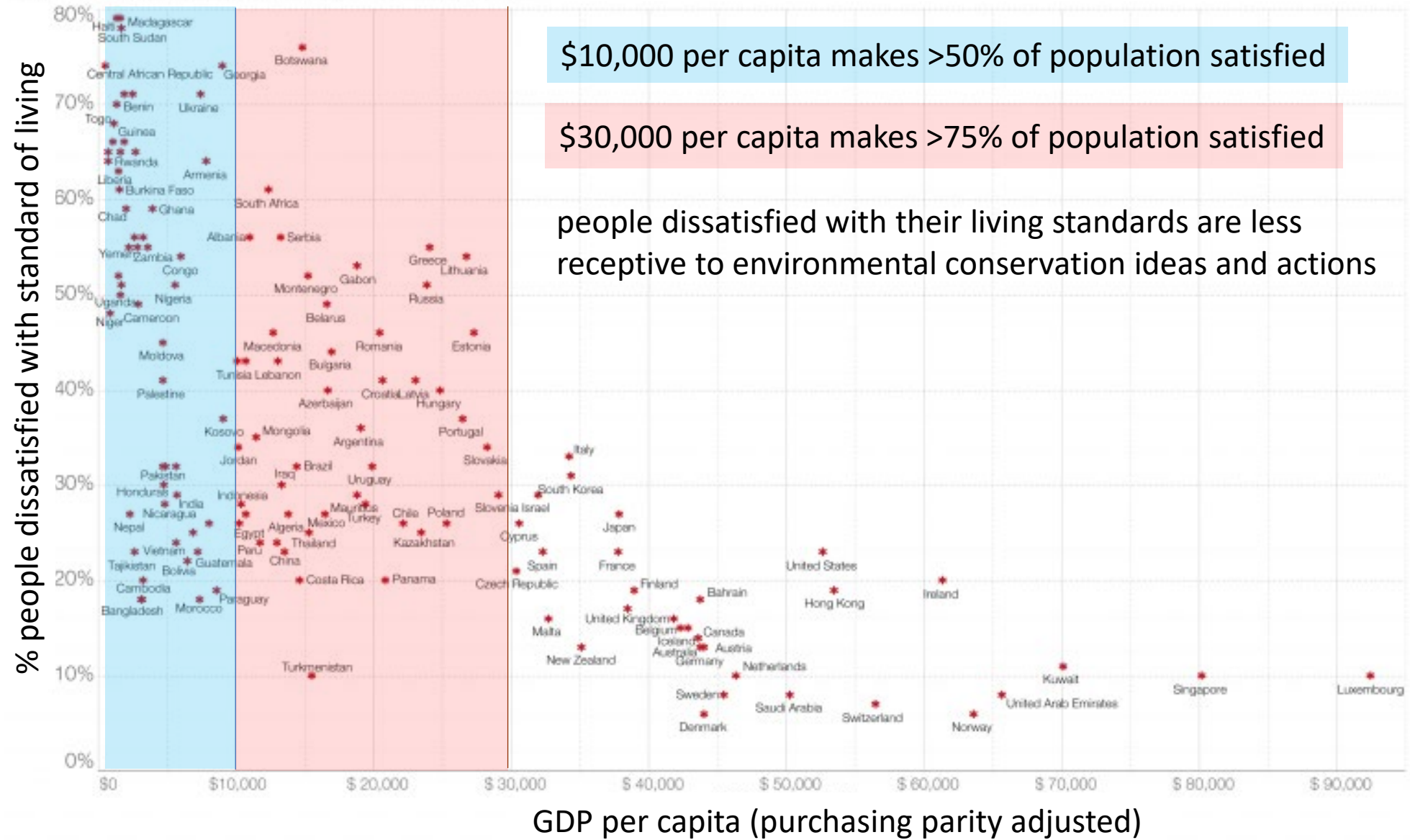


Our World in Data



Dissatisfaction with standard of living vs GDP per capita

Shown on the y-axis is the share that answered 'dissatisfied' to the question "Are you satisfied or dissatisfied with your standard of living, all the things you can buy and do?"

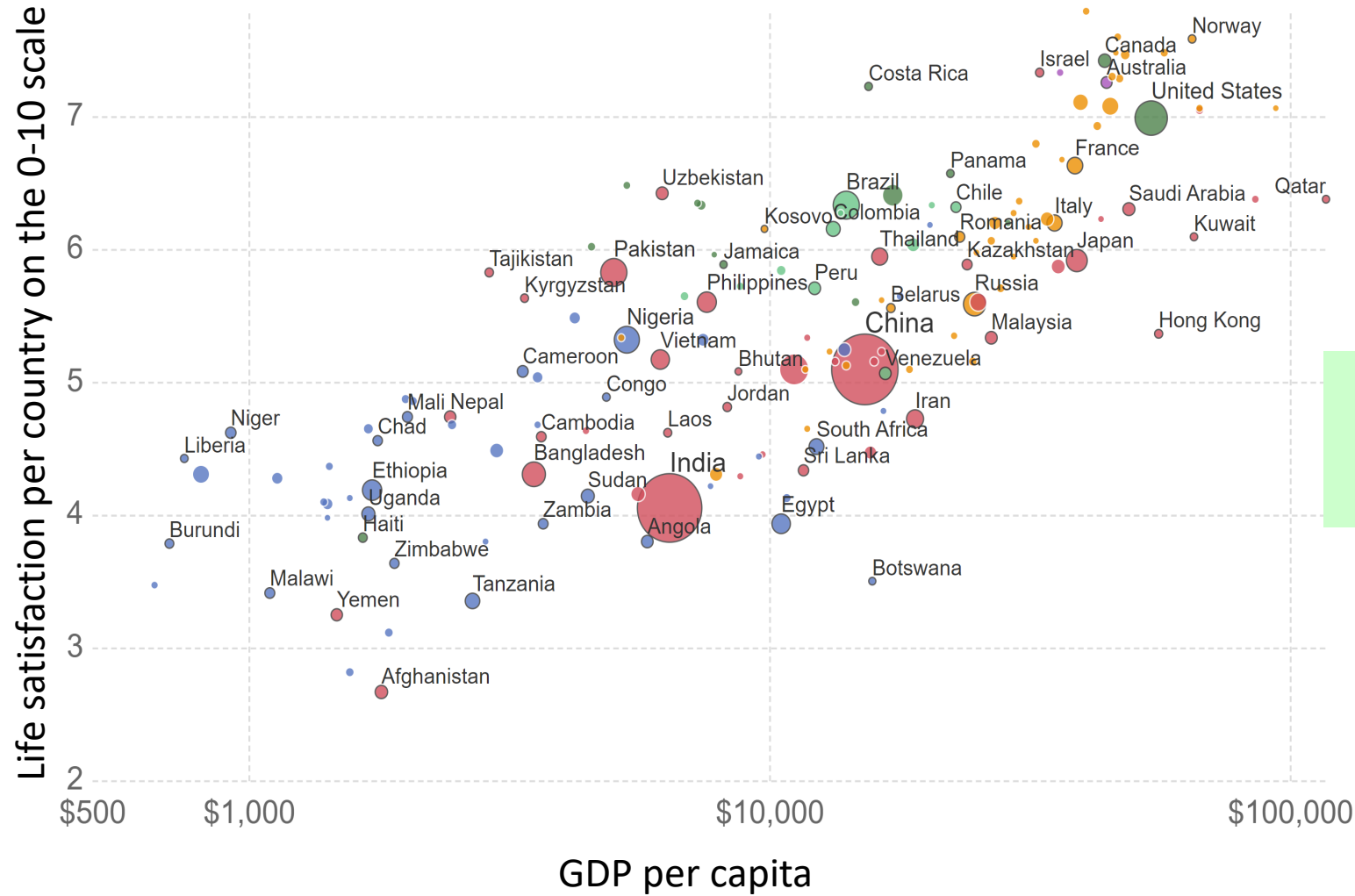


Data source: GDP per capita data from the World Bank; survey data on the satisfaction with living standards from the Gallup World Poll. The visualization is available at [OurWorldInData.org](https://ourworldindata.org) where you find more visualizations and research on global development.

Licensed under CC-BY-SA by the author Max Roser.

Can money buy you happiness?

Our World
in Data

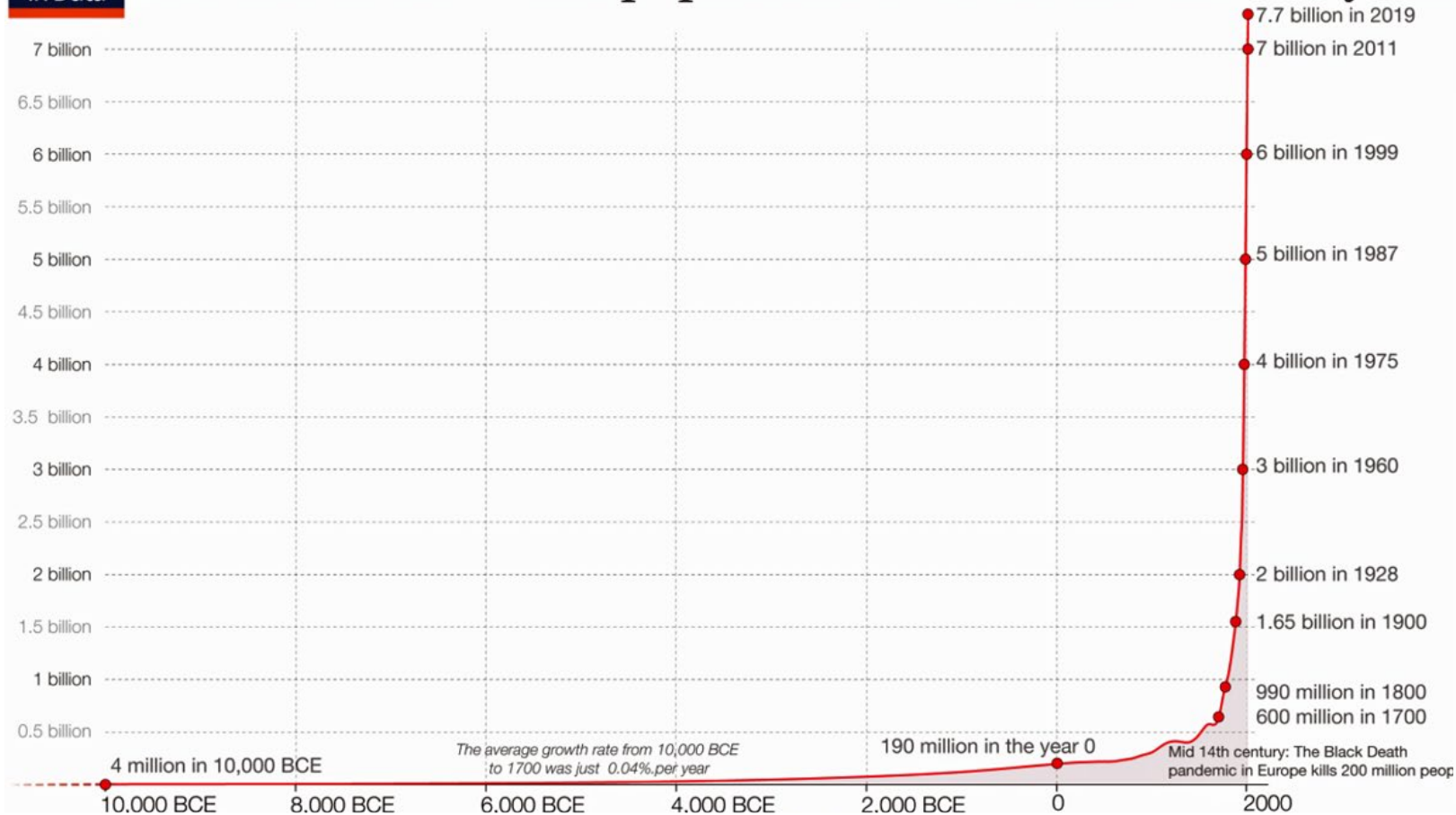


Yes, but happiness is expensive as it increases with $\log(\text{wealth})$

Human population size: key to all conservation considerations

Our World
in Data

The size of the world population over the last 12,000 years



10 March 2021

Current World Population

7,851,108,980

[view all people on 1 page >](#)

TODAY

Births today

69,026

Deaths today

28,979

Population Growth today

40,047

THIS YEAR

Births this year

26,167,252

Deaths this year

10,985,639

Population Growth this year

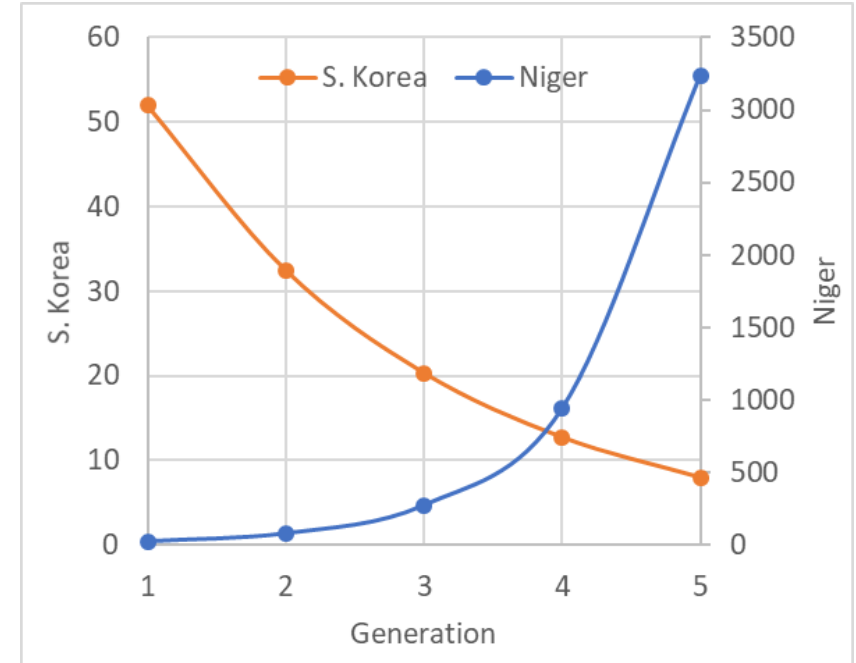
15,181,612

Population growth modelled as a simple exponential process becomes always scary, and rarely realistic, over time



64th chessboard square: $2^{63} = 10^{19}$ rice grains
50 kg per m² of the entire India territory

Human population growing 2% annually will double every 35 years

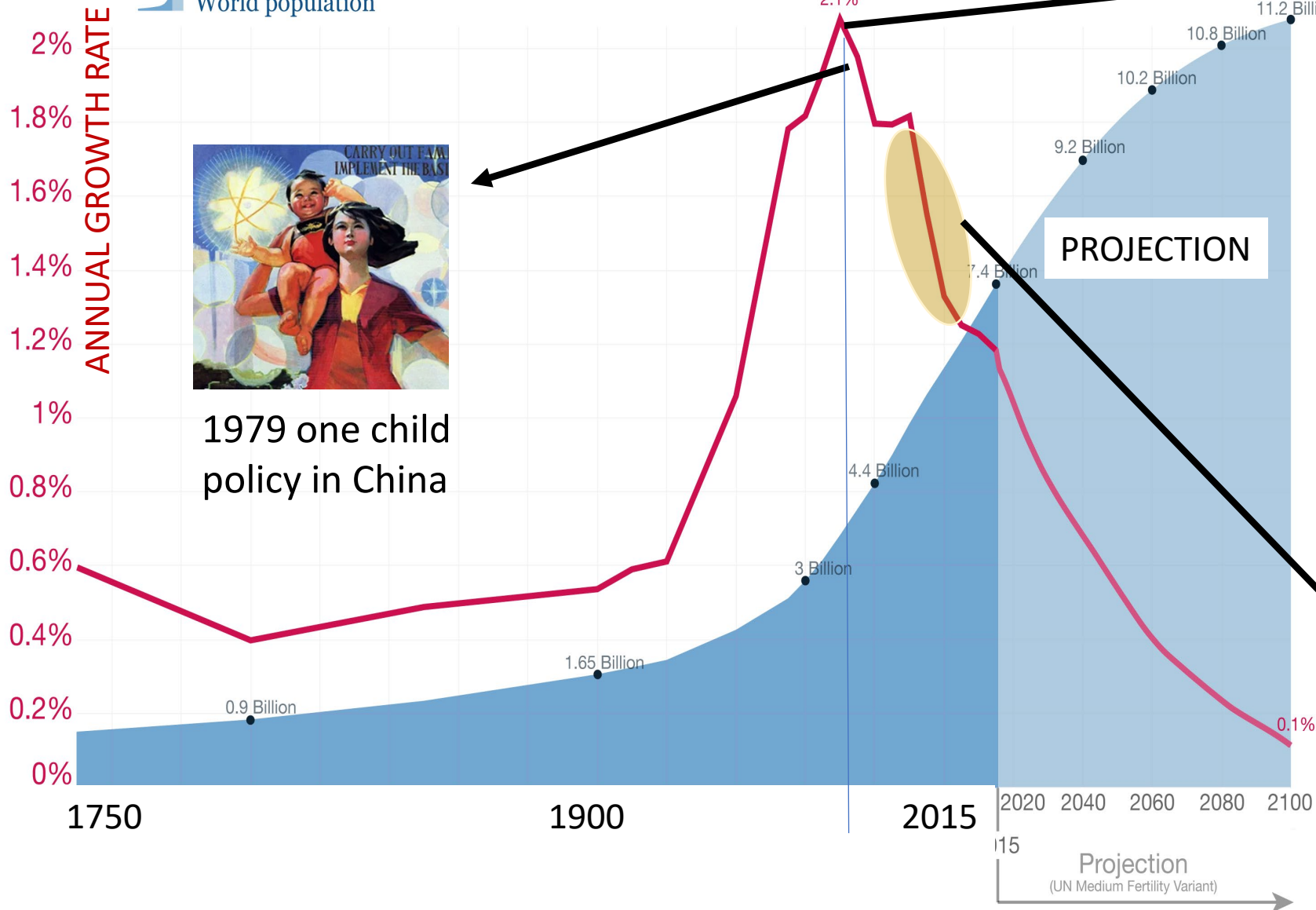


S. Korea: with its current fertility 1.43 children per woman (world's lowest), its population will decline from 52M to 8M people in 5 generations

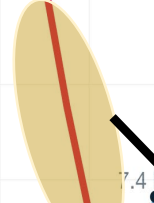
Niger: with 6.89 children per woman (world's highest) its population will increase from 23M to 3.2B people in 5 generations

World population growth, 1750-2100

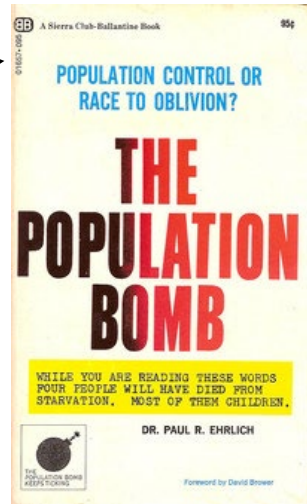
Annual growth rate of the world population
World population



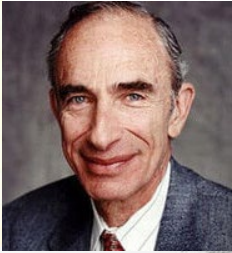
1979 one child policy in China



PROJECTION



1968 justified panic



Scientific failure:
we did not predict slowdown
in exponential growth

we do not understand
the population dynamics
of our own species!

Chinese *one child policy* should not be repeated for its harmful side effects, but was it effective for population control?



The Astonishing Population Averted by China's Birth Restrictions: Estimates, Nightmares, and Reprogrammed Ambitions

Daniel Goodkind¹

DEMOGRAPHY

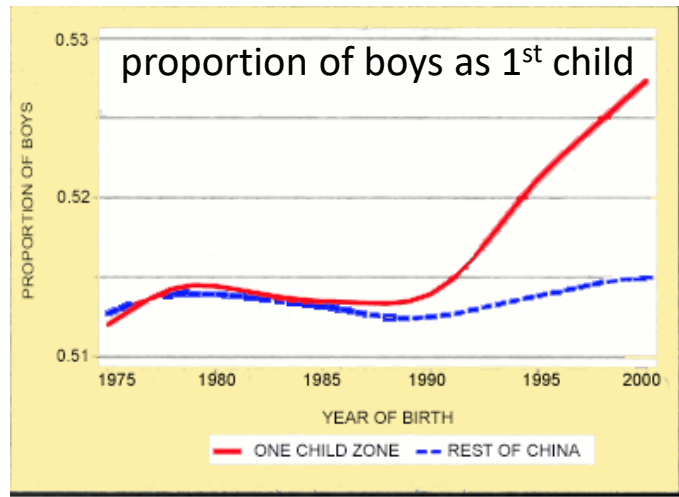
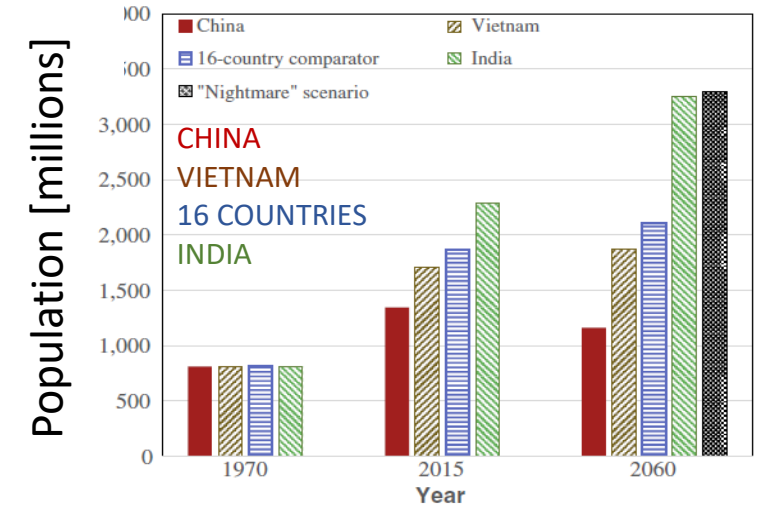
Analysis of China's one-child policy sparks uproar

Colleagues call demographer's findings flawed and irresponsible

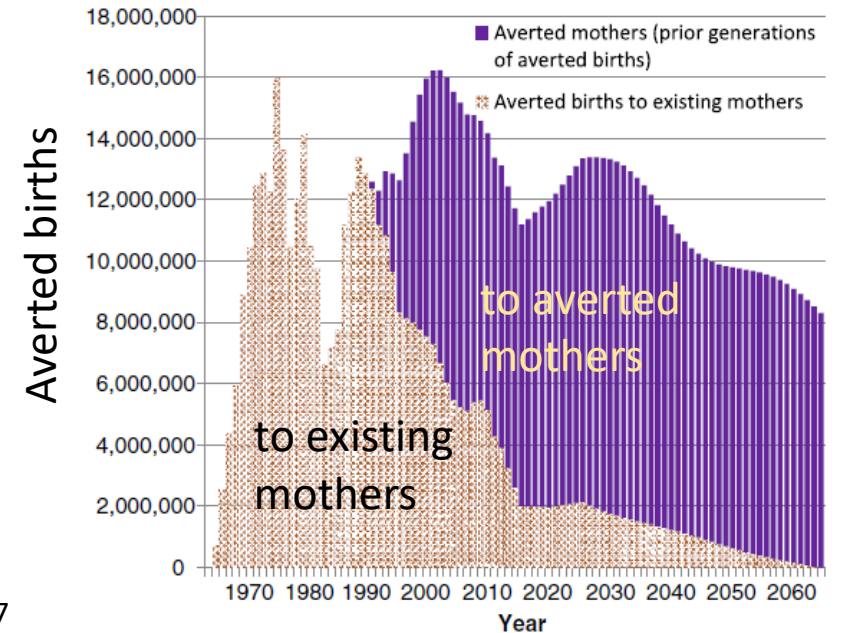
By Mara Hvistendahl

- official China estimate of 400 million births averted
- internationally rejected as greatly exaggerated
- demographic projections suggest 360–520 million averted births as of 2015
- the estimate is projected to double by 2060

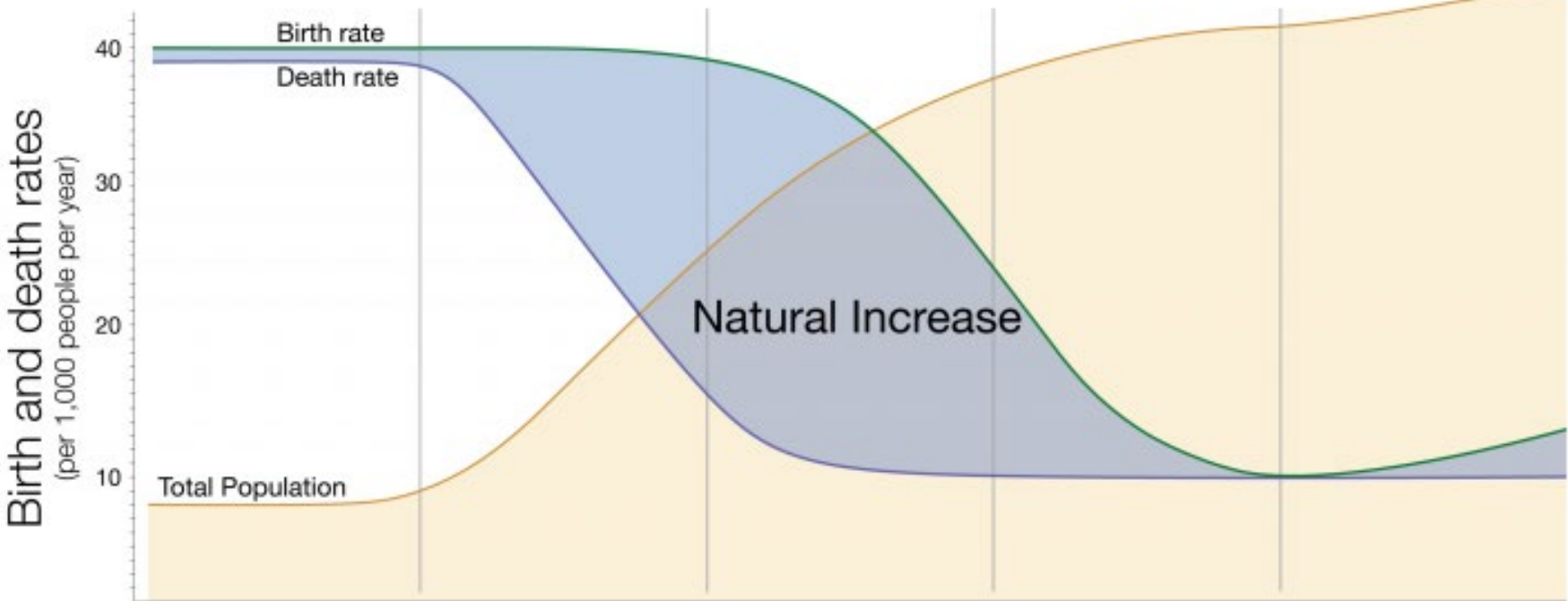
conclusions criticized as “scientifically highly flawed and morally irresponsible,” real problem: it is a non-replicated experiment



Unexpected side-effect of one child policy: too many boys (abortions of girls)



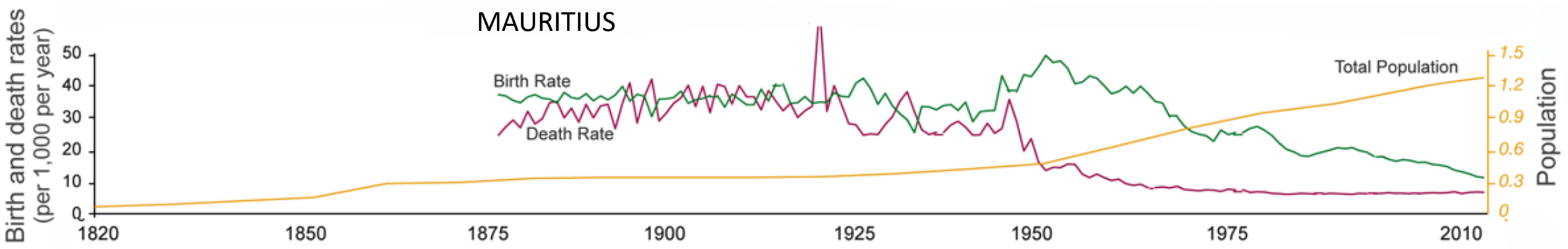
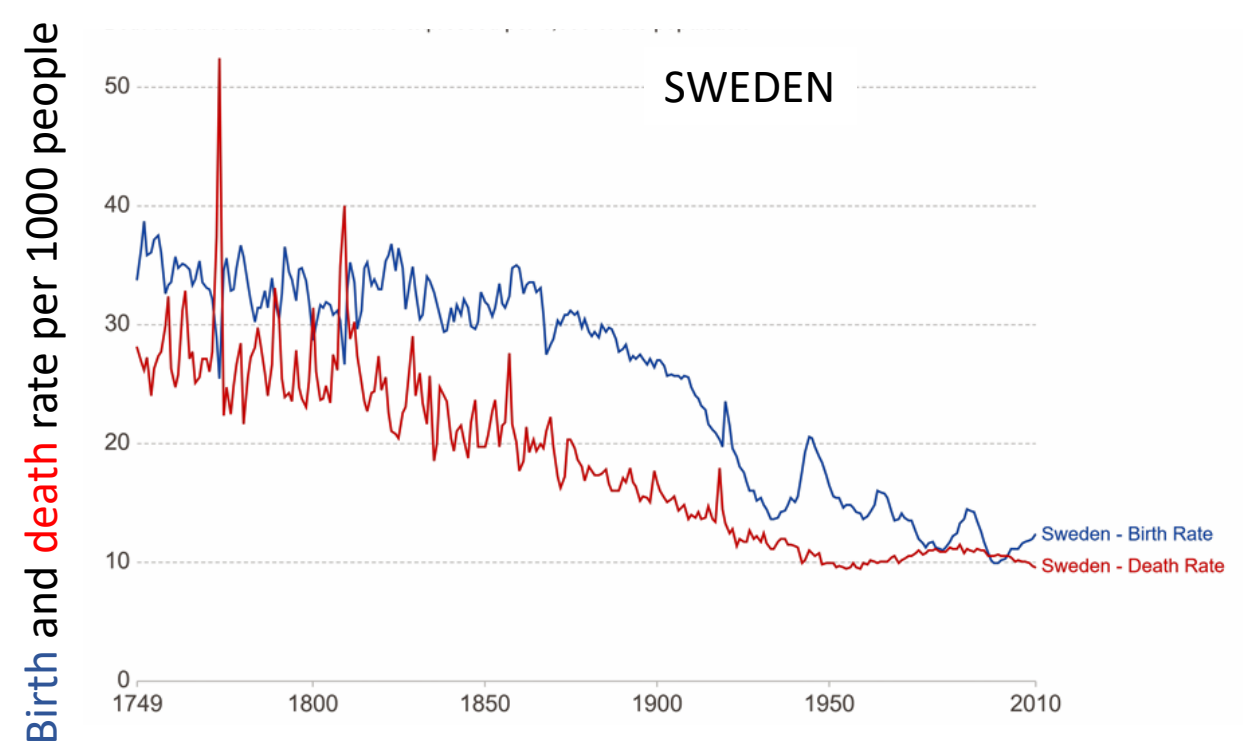
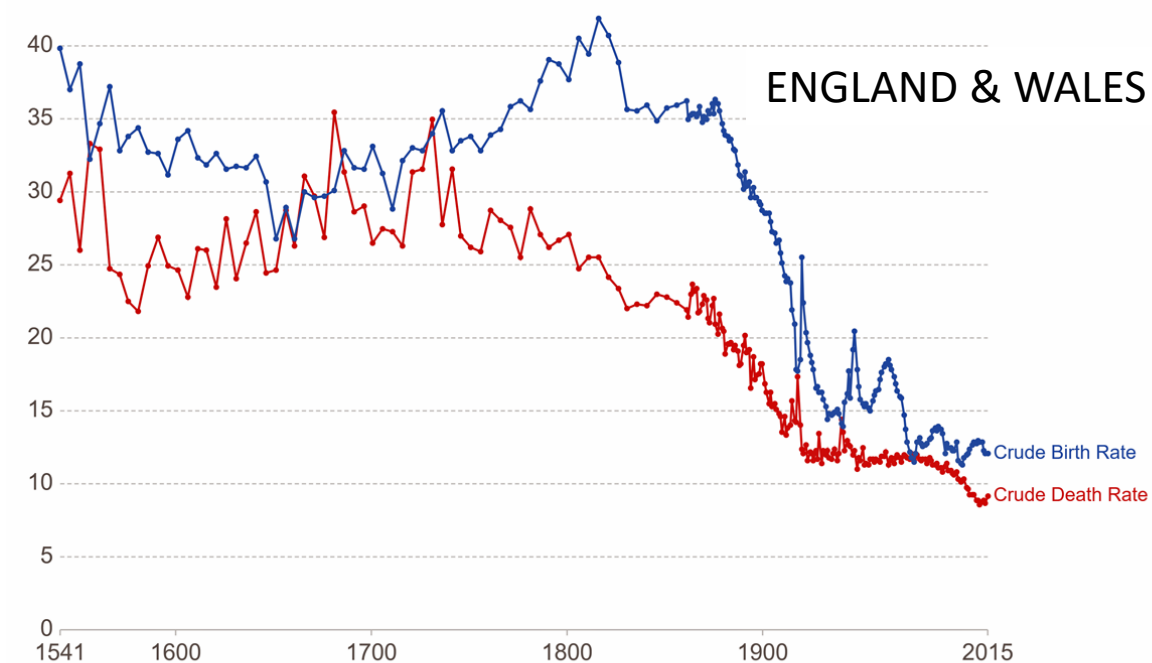
The demographic transition in 5 stages



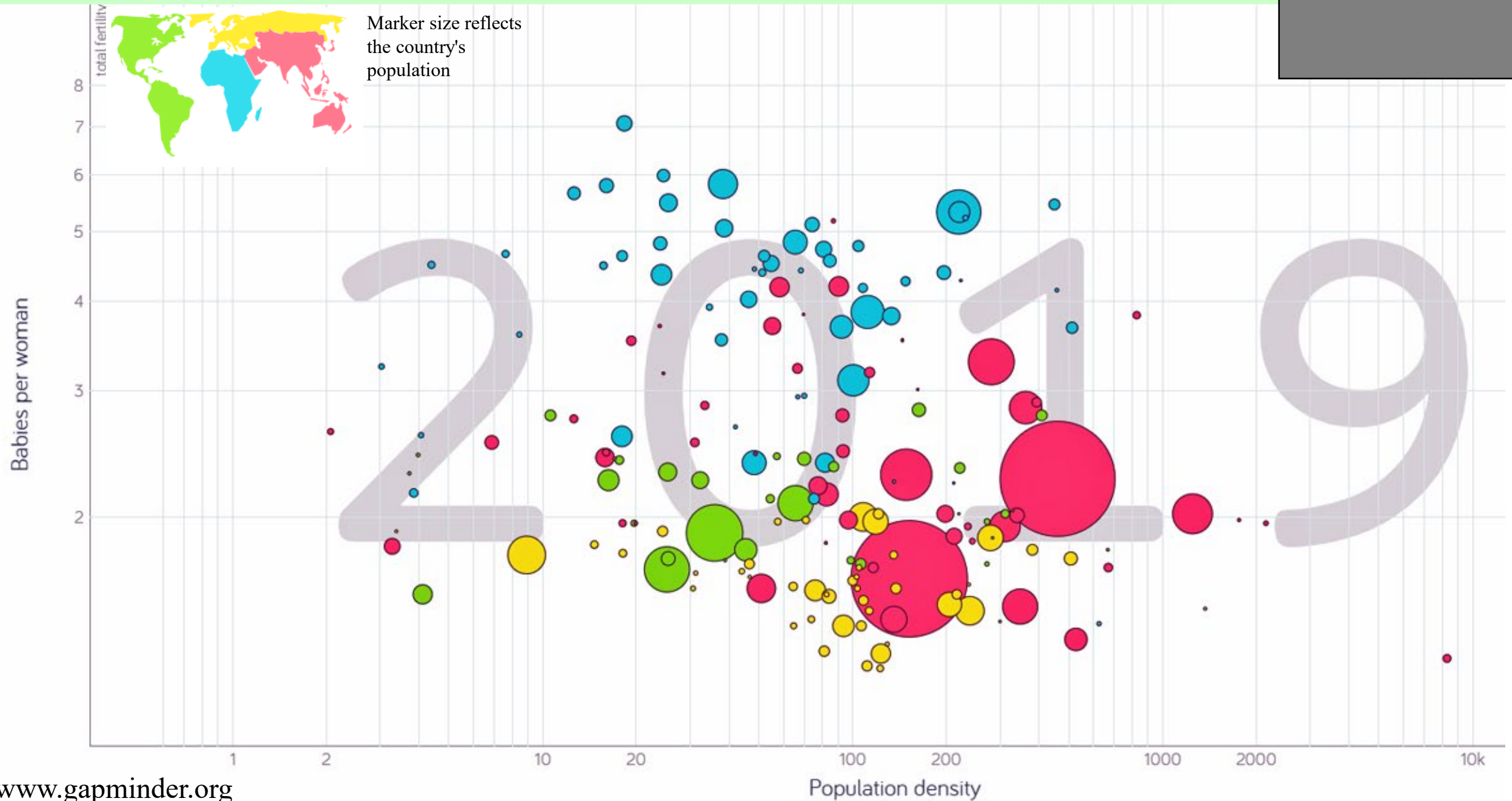
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Birth rate	High	High	Falling	Low	Rising again
Death rate	High	Falls rapidly	Falls more slowly	Low	Low
Natural increase	Stable or slow increase	Very rapid increase	Increase slows down	Falling and then stable	Stable or slow increase
Population Pyramid					

The author Max Roser licensed this visualisation under a CC BY-SA license. You find more information at the source: <http://www.OurWorldInData.org/world-population-growth>

Demographic transition: a predictable process

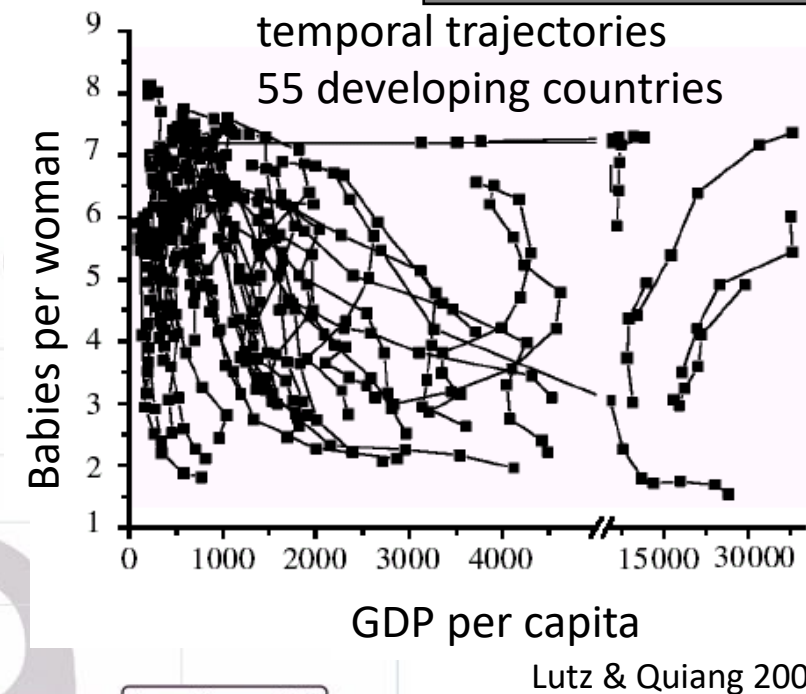
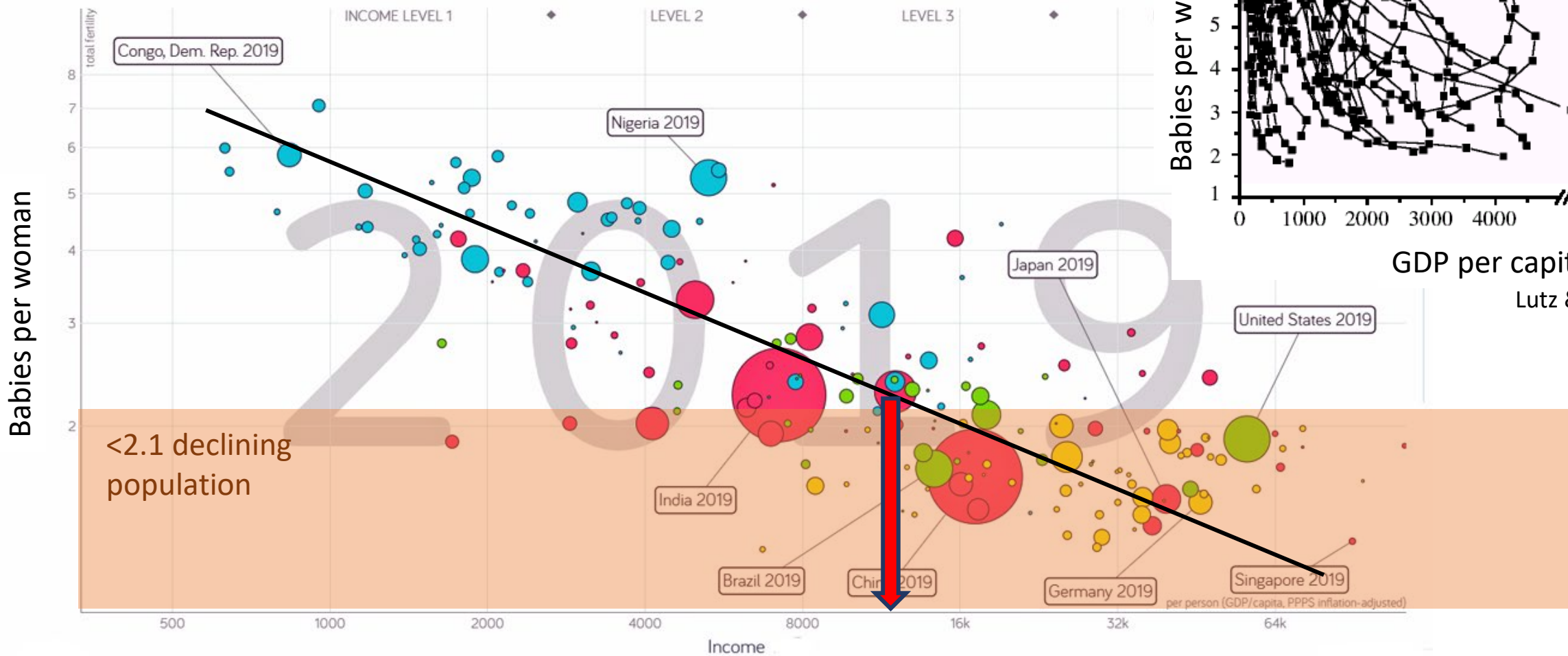


Bad news: Human fertility is not density-dependent

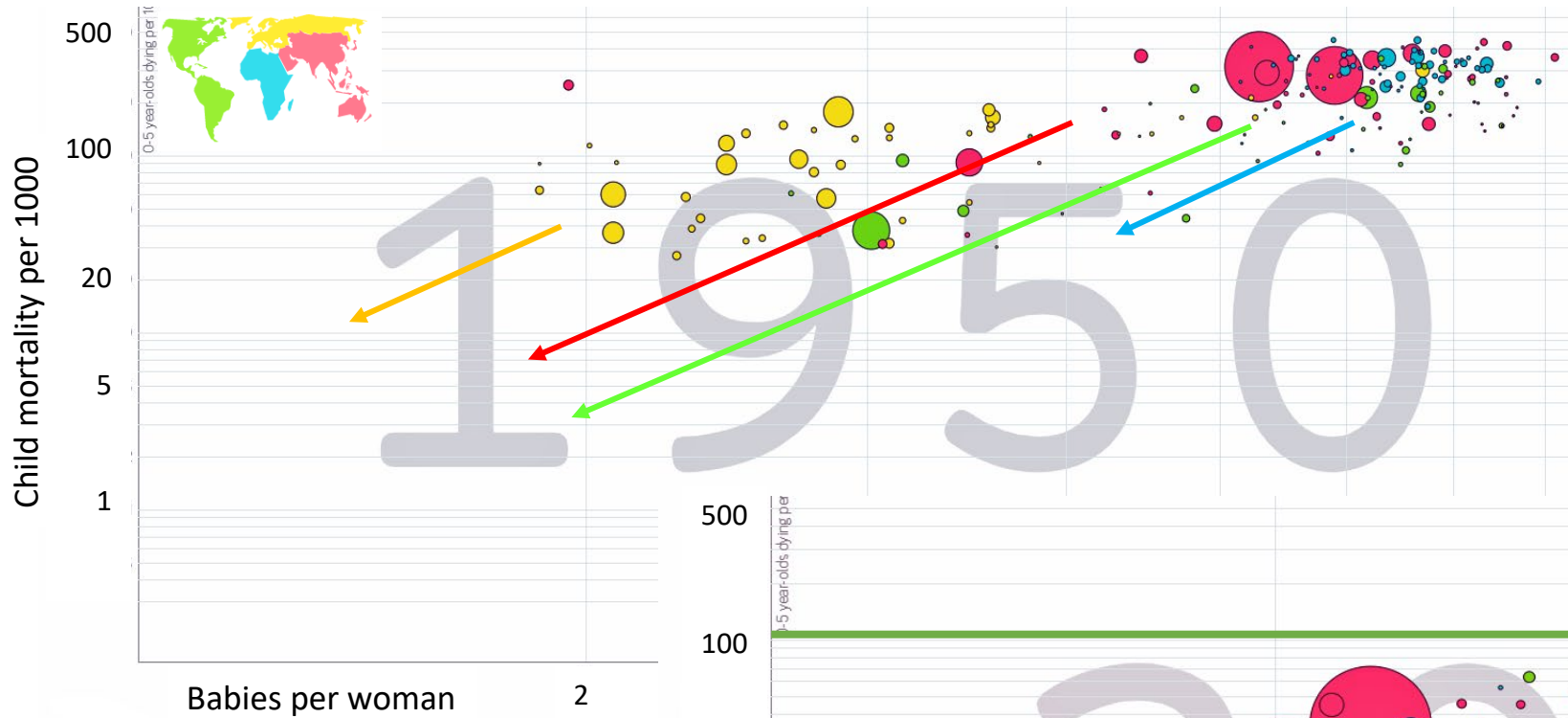


Good news: Human fertility is income-dependent

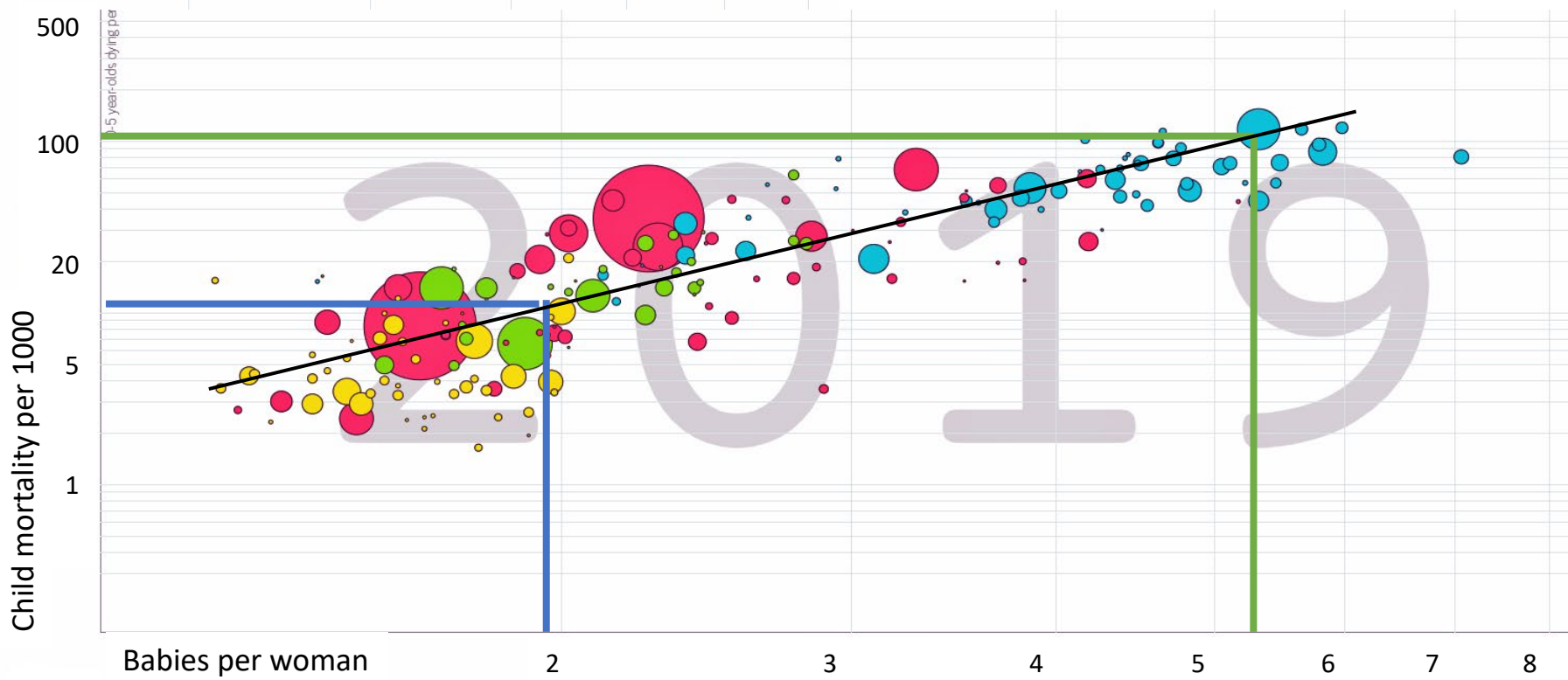
“Sri Lankan life style for everybody”: We need to get everybody on \$12,000 to achieve sustainable population



Life-time fertility is correlated with infant mortality



Demographic transition
1950 -----> 2019

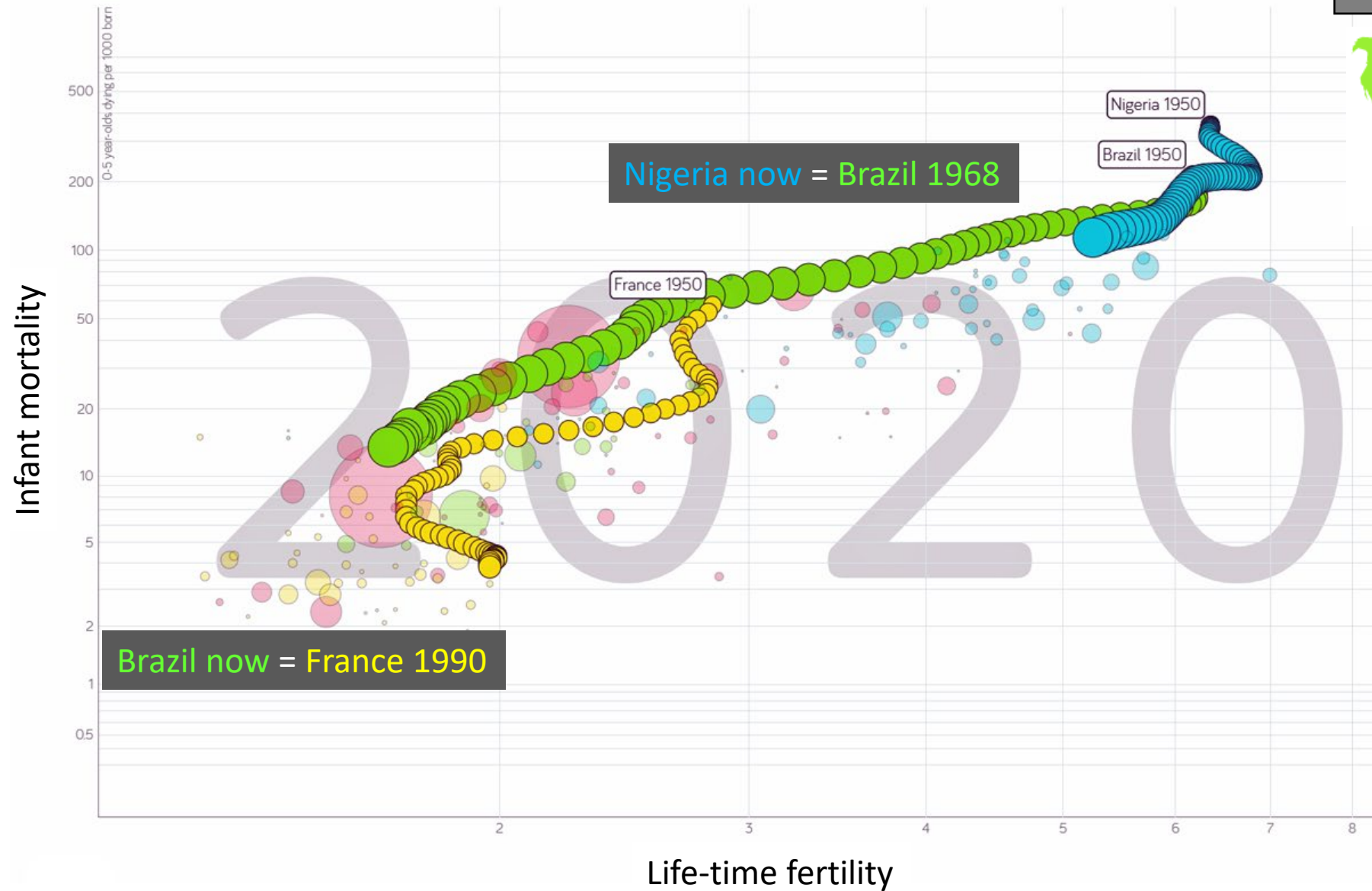


Human populations overcompensate for infant mortality:
mortality 1% ~ 2 babies per mother
mortality 10% ~ 5.2 babies per mother

100 mothers – 200 babies – 2 die, **198 live**
100 mothers – 520 babies – 52 die, **468 live**

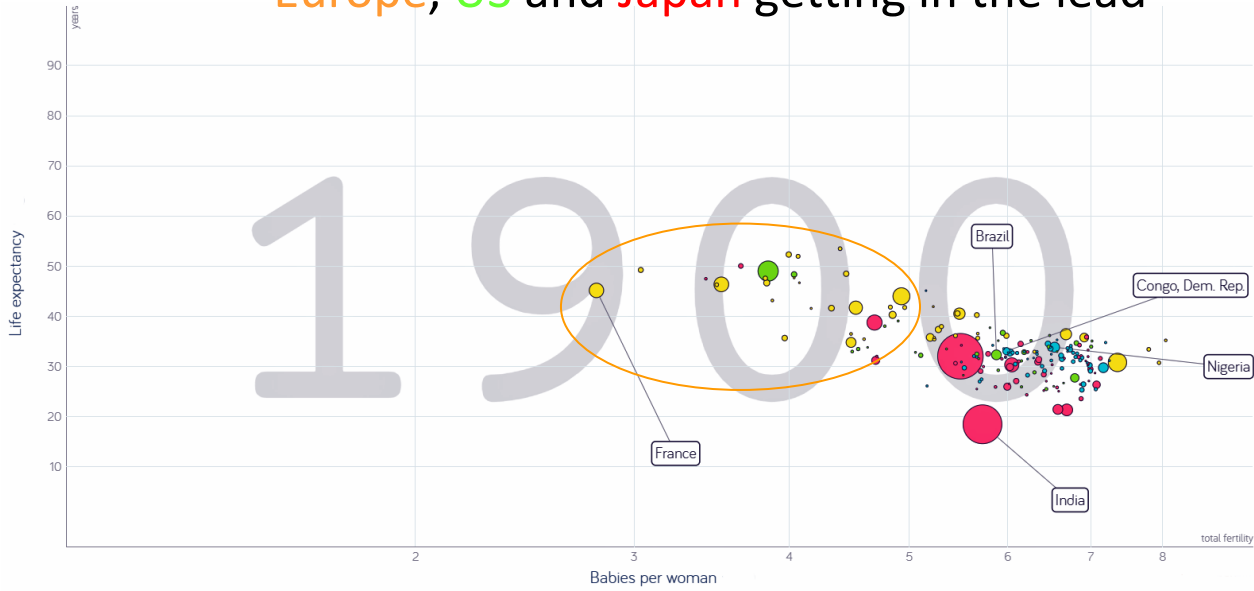
Life-time fertility is correlated with infant mortality

Trajectory 1950 – 2020 for Nigeria, France, Brazil

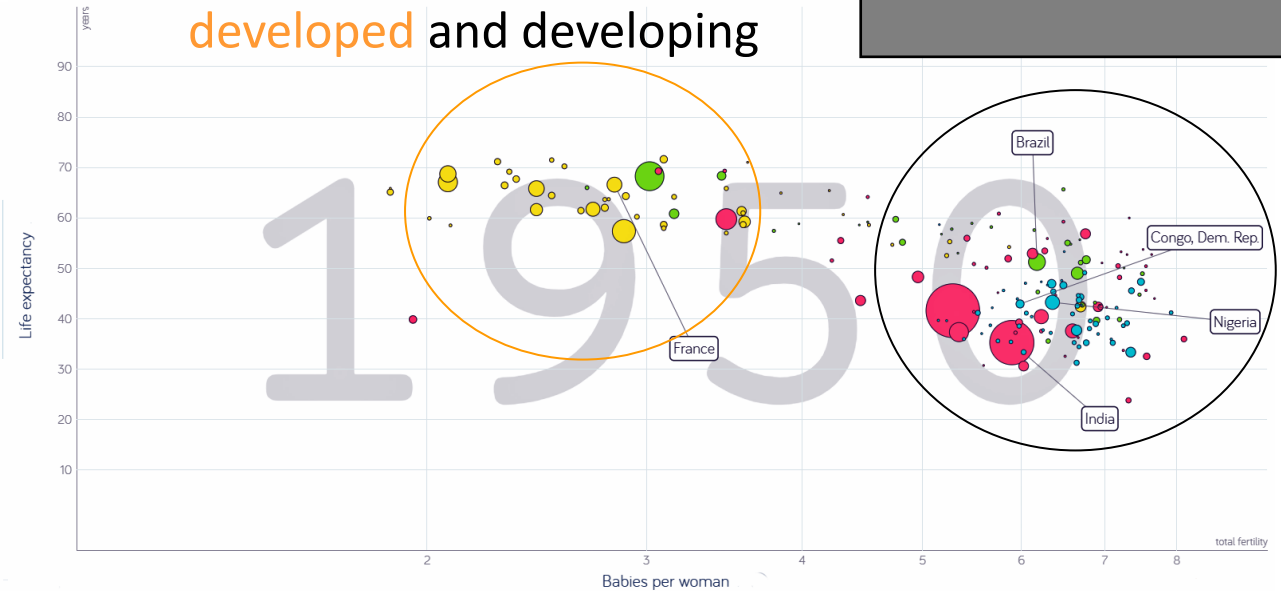


Long-living people have fewer children

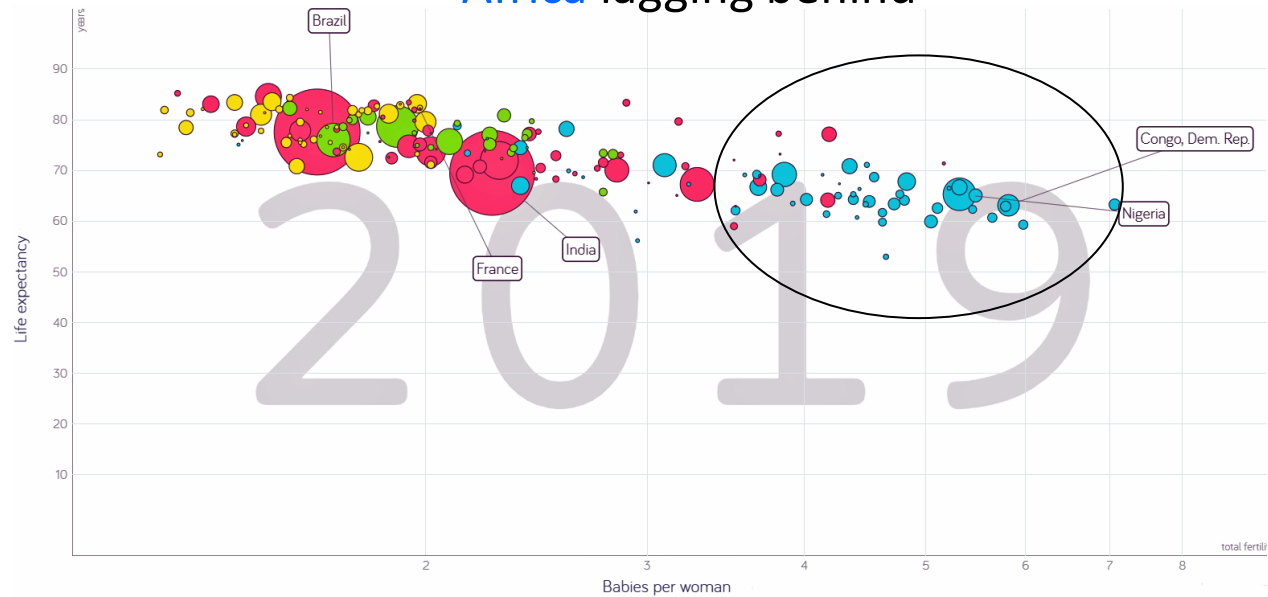
Europe, US and Japan getting in the lead



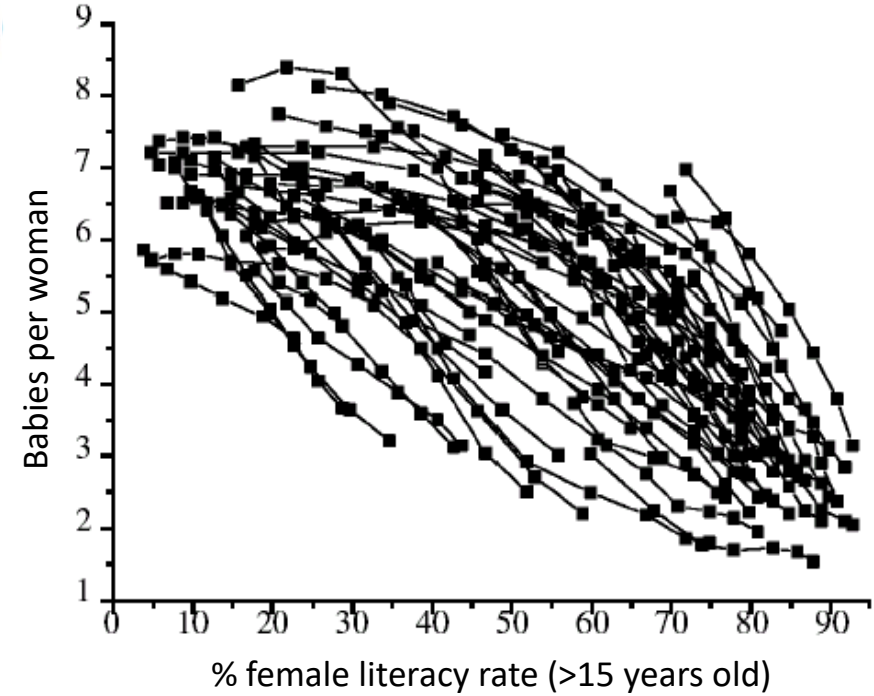
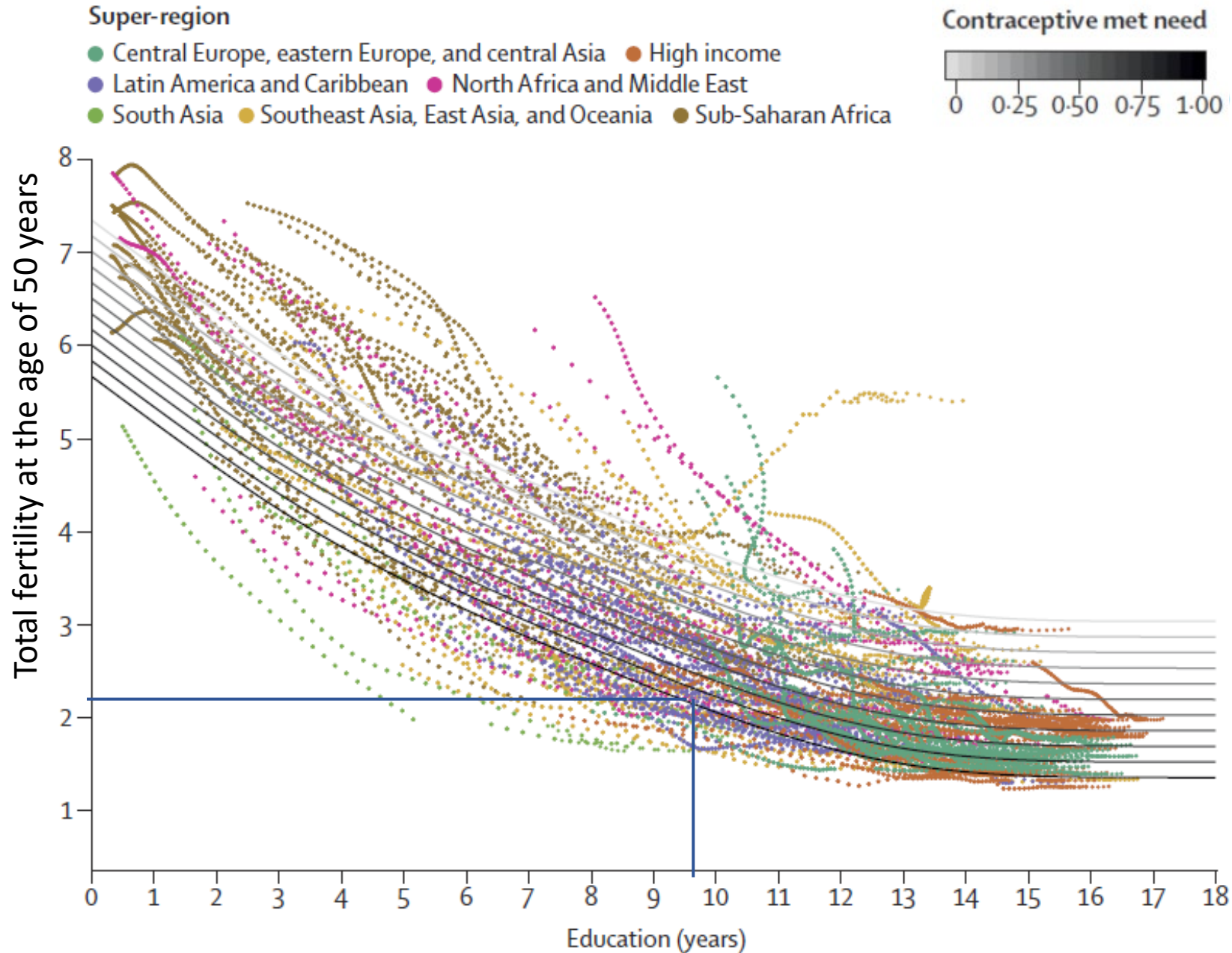
Two distinct worlds:
developed and developing



Africa lagging behind



Fertility trajectories of individual countries with models for education and contraceptive access to women



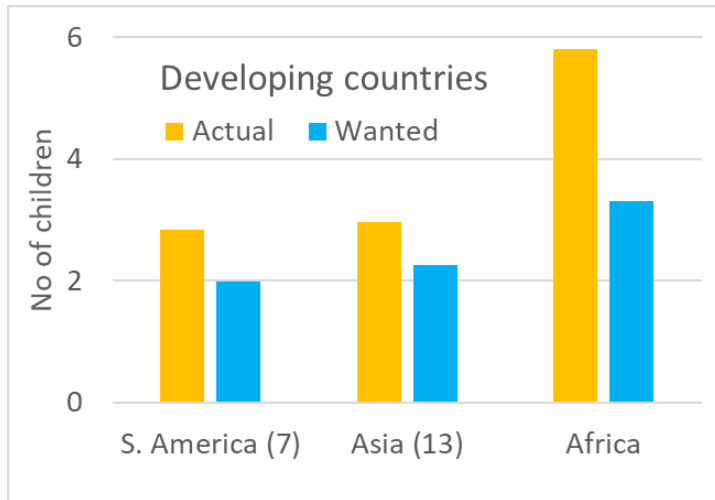
Sustainable population:
full access to contraceptives and
10 years of education for all women

Lutz & Quiang 2002

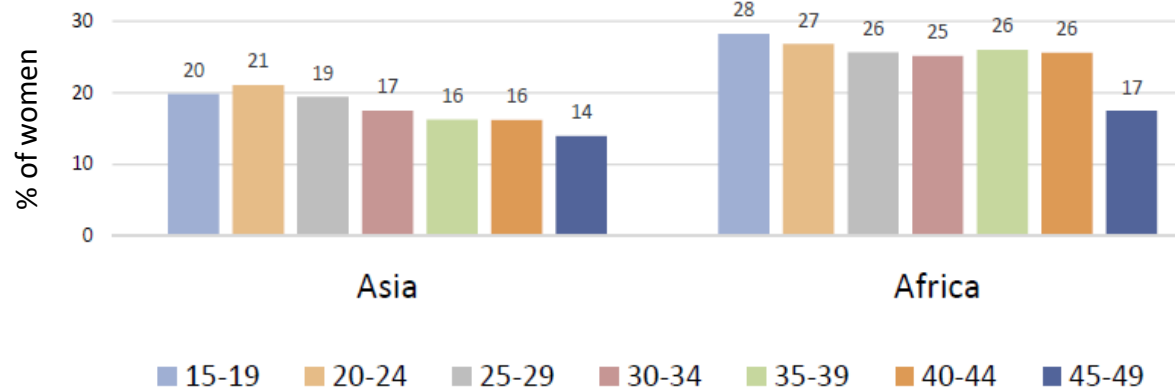
Vollset et al., Lancet 2020; 396: 1285–306

Birth control

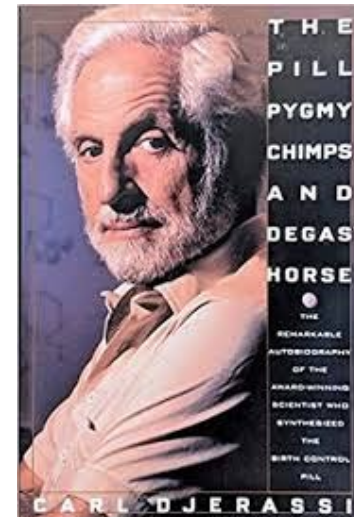
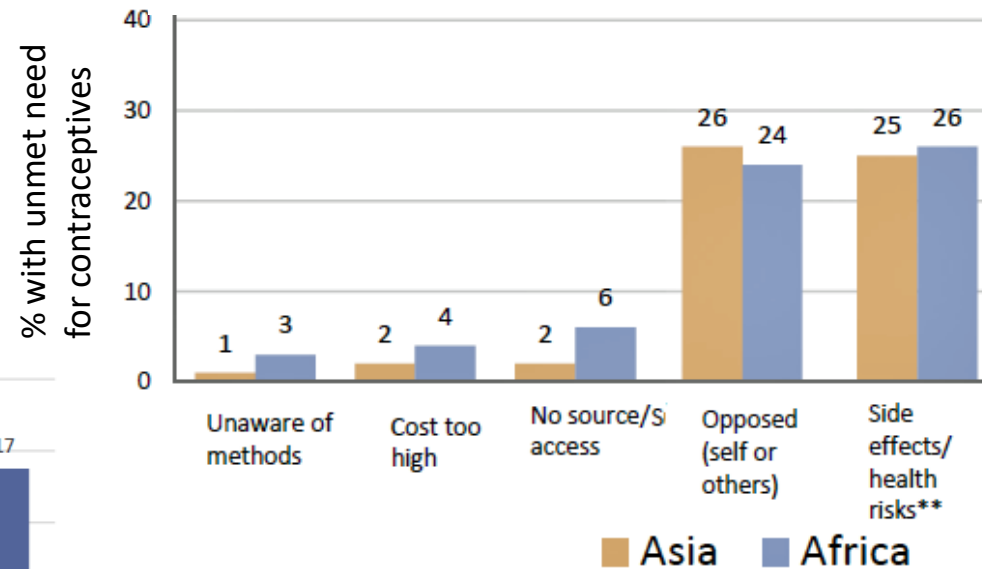
- People have more children than they want to
- Many women in developing countries have unmet needs for contraceptives
- The main problem is opposition and side effects of contraceptives, not knowledge or cost
- Developing new contraceptives is not a commercially appealing proposition to pharmaceutical companies



Unmet needs for contraception



Main factors preventing contraceptive use





Marie Stopes (1880 – 1958) a British author, palaeobotanist, eugenicist and women's rights campaigner.



2020



Marie Stopes International global presence: 37 countries



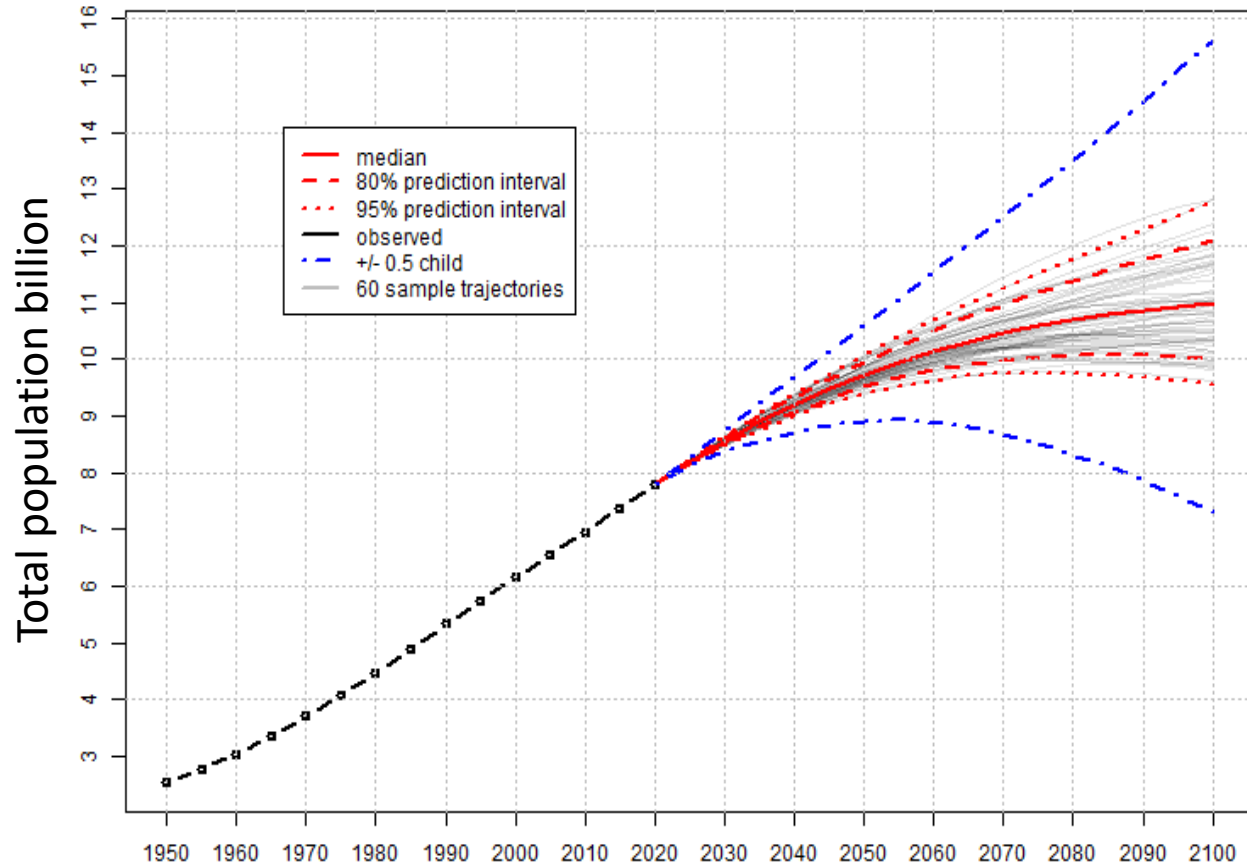
About MSI ▶

- Operates in 37 countries
- In over 600 MSI owned clinics
- In partnership with over 2,900 private practitioners
- Partners with governments to serve over 30,000 community outreach locations

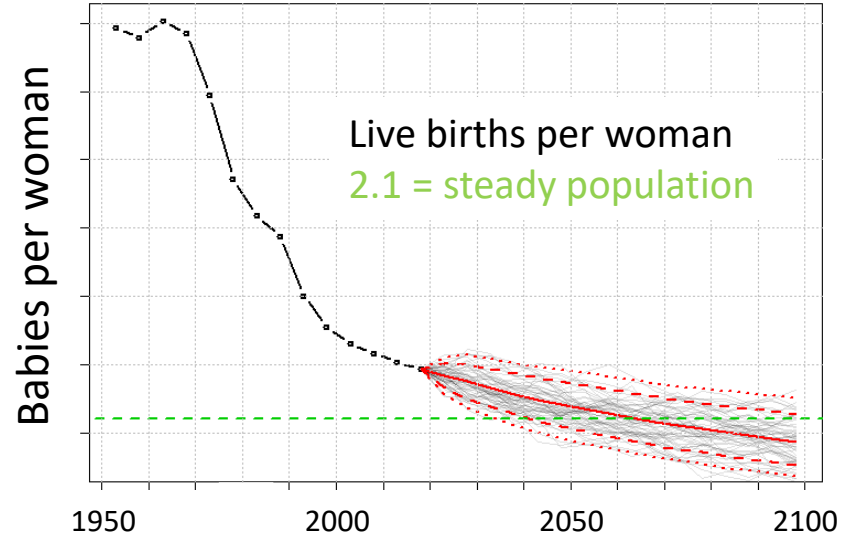


The population growth has been terrifying – but not any longer!

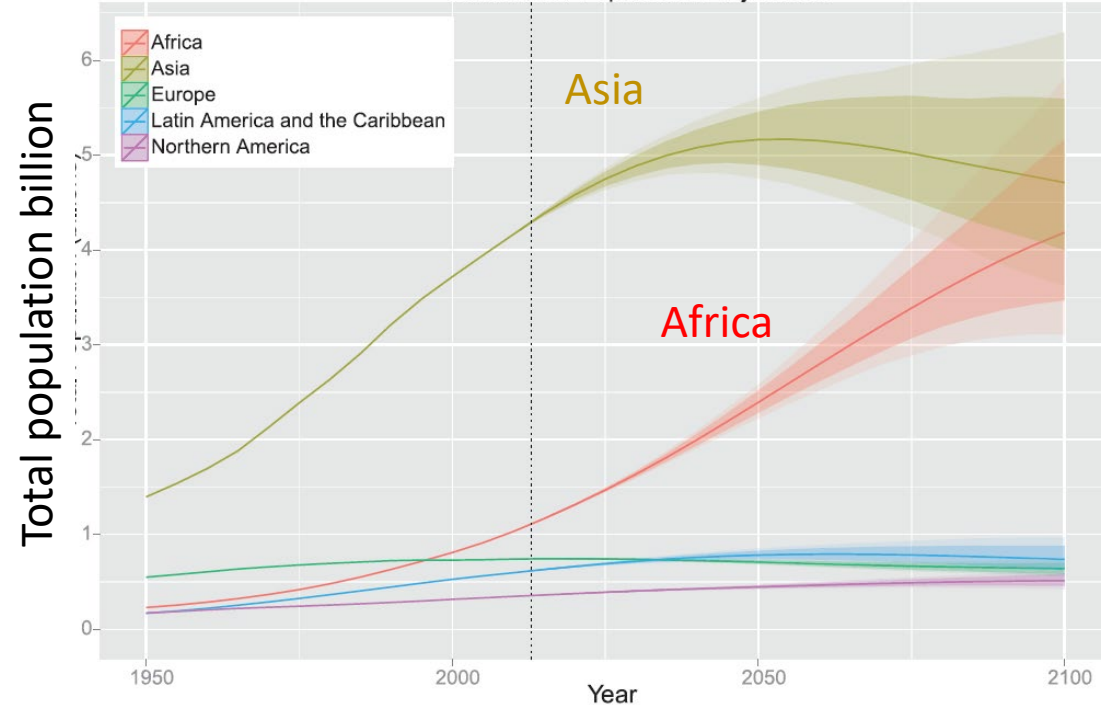
Total population



© 2019 United Nations, DESA, Population Division. Licensed under Creative Commons license CC BY 3.0 IGO.
United Nations, DESA, Population Division. *World Population Prospects 2019*. <http://population.un.org/wpp/>



Continental Population Projections



Global population growth after 2050 will be driven entirely by Africa – but its demographical models remain uncertain

Population predictions to 2100 based on various scenarios of the education progress and contraceptives accessibility

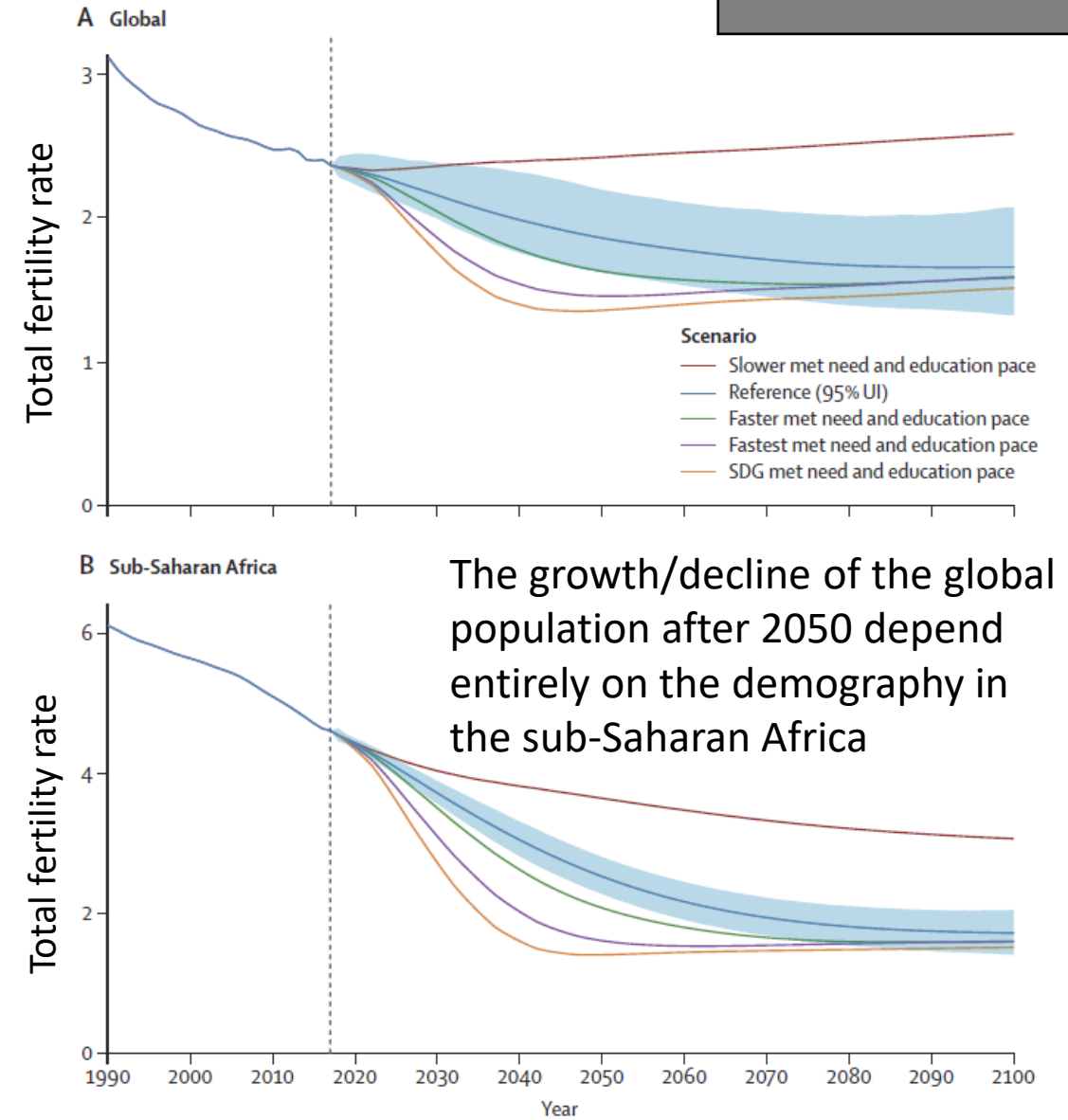
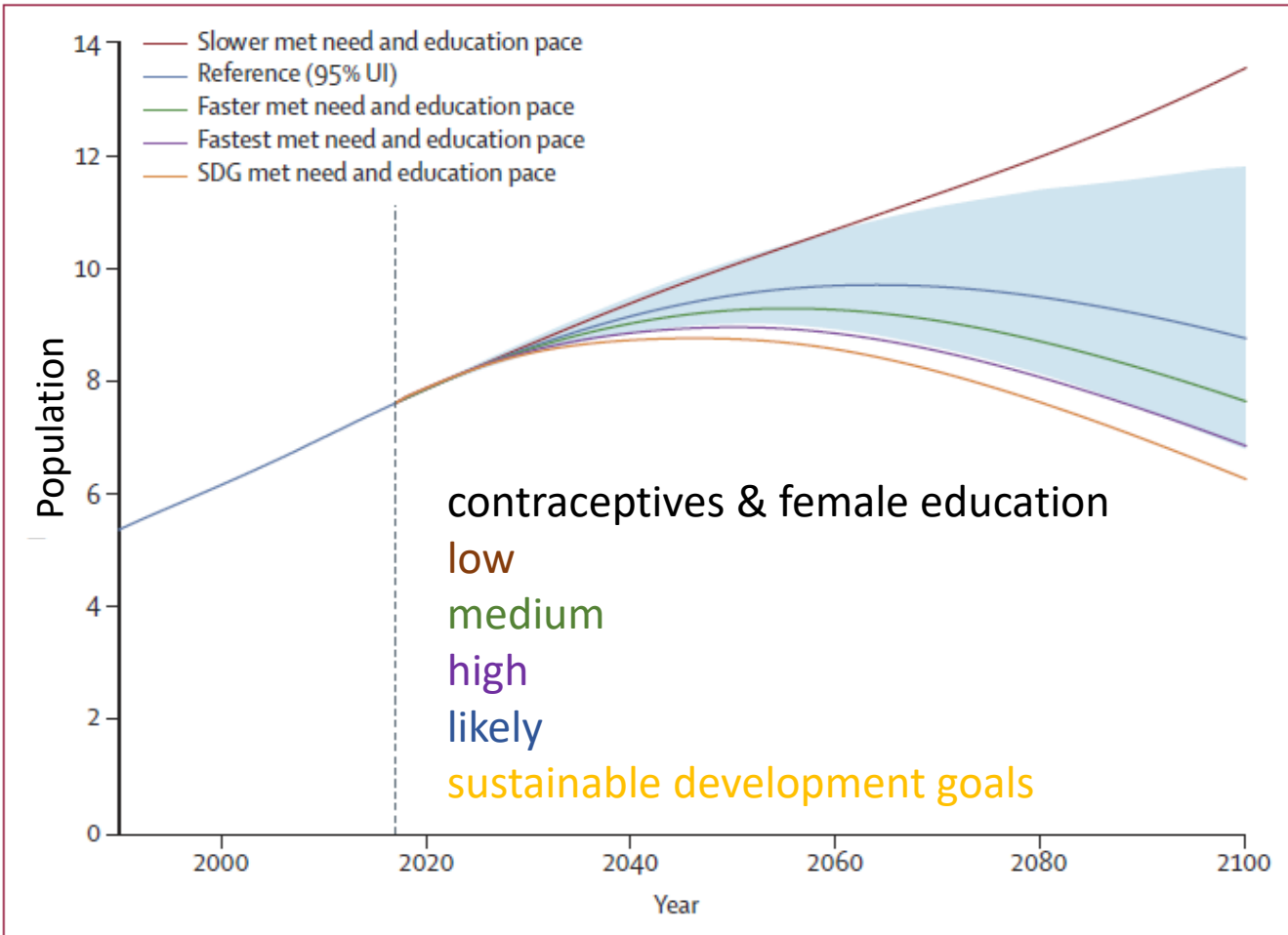
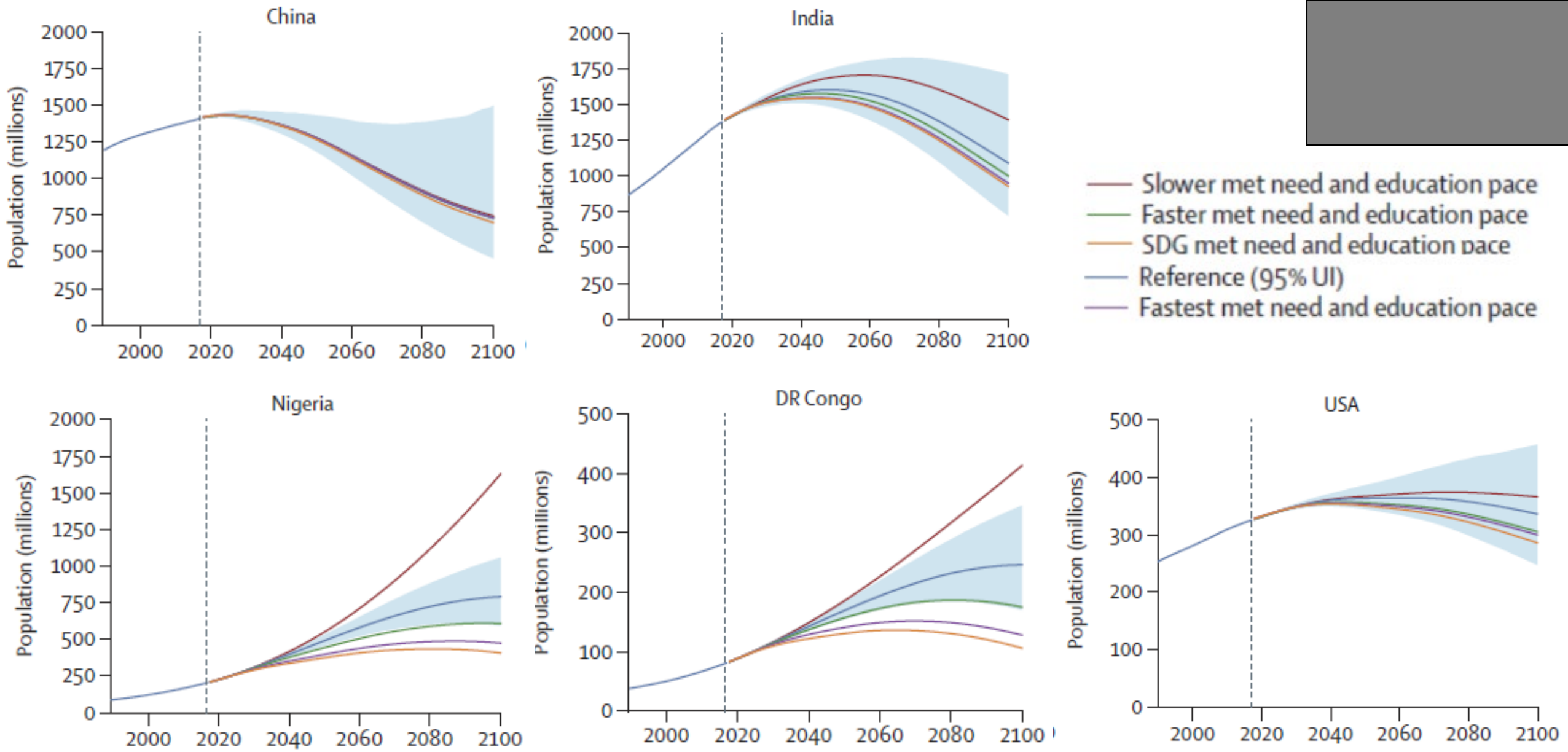
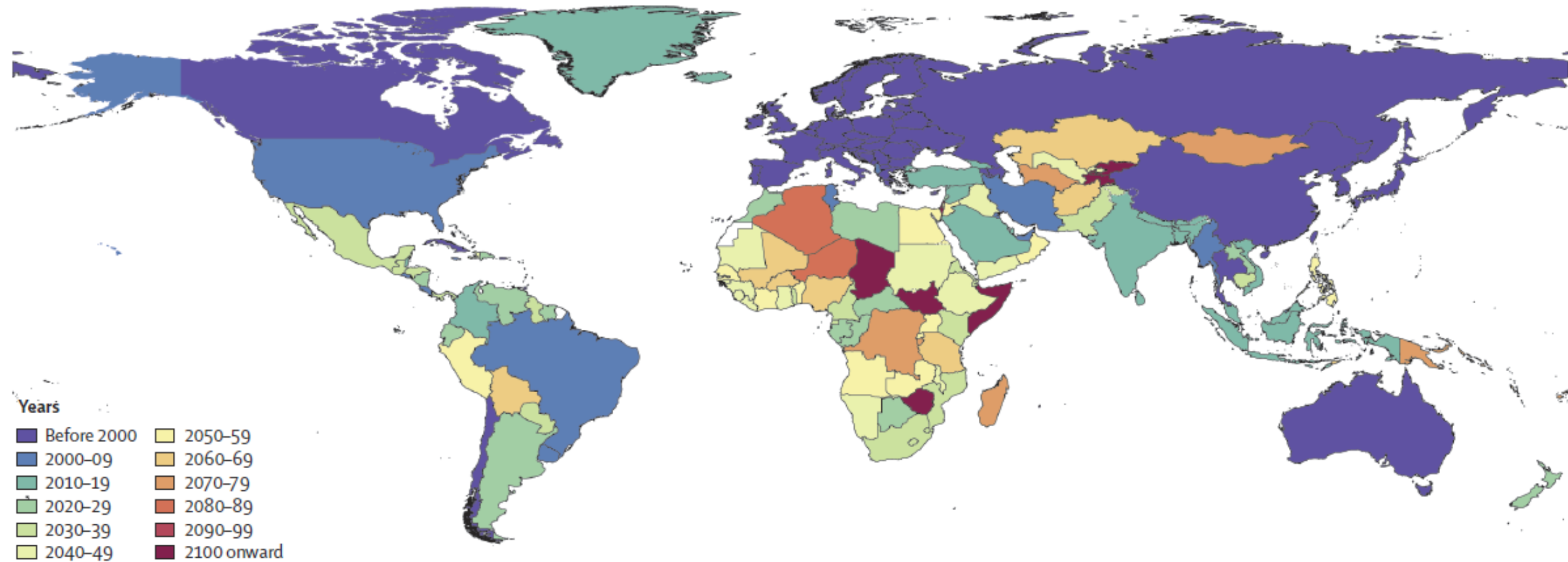


Figure 5: Global population in the reference, slower, faster, fastest, and SDG pace scenarios, 1990–2100



The year that the net reproduction rate falls below the replacement level





Nine Conclusions

Primary problem: growing human population

Good news: Human fertility is income-dependent

More good news: in 30 years, many people lifted from poverty,
saving us from the over-population catastrophe

Ozone hole lesson: technology, not social engineering, solves environmental problems.
Conservation is not a religion rewarding ascetic life style or cultivating apocalyptic expectations!

Techno-optimism: technology to solve pressing environmental problems (and cause new ones)
unless stifled by too precautionary approach [generic engineering!]

Technology to create wealth necessary to keep the global population falling

“Sri Lankan life style for everybody”: \$12,000 per year to achieve sustainable population and
also get more than 50% of population satisfied with their living standards

Access to contraceptives and 10 years of education for all women for sustainable population

Whether the world will overpopulate or not in 21st century is in the hands of Africans.
Perhaps we could help them?

The End Is Nigh?



Waiting for a happy apocalypse has a long (religious & environmental) tradition