

Rewolucja technologiczno-gospodarcza

Technologies that changed the world?



- TECHNOLOGIA = od greckiego słowa τέχνη („technè”) oraz „logos”

τέχνη („technè”) = wytwarzanie, rzemiosło, materię, sztukę

Czy technologia i postęp technologiczny towarzyszyły nam od zawsze?

Rozumienie technologii „przedtem” i teraz?
„przed czym”?

Technology – timeless value

- Technology = the idea
- Puts human/tacit knowledge and ideas into work
- „experience of success and failure” (Dosi, 1982)
- Embodied knowledge → spread of knowledge

Noria (w Hama)–starożytna maszyna hydrauliczna, tzw. koło wodne



Motorola DynaTAC 8000X (1973)



Dlaczego technologia i postęp technologiczny są ważne?

- Zmiany jakościowe – rozwój gospodarczy
- Zmiany ilościowe – wzrost gospodarczy
- Produktywność (!)
- **Sieci** społeczne, ekonomiczne, instytucjonalne
- **Asymetrie** informacyjne i **efektywność** rynków

Różne etapy rozwoju technologicznego – różny wpływ (rodzaj i intensywność)

Kluczowe: rozprzestrzenianie się i powszechny dostęp

Society + Economy + Technology = Evolutionary System

- ‘history of technological progress is **inseparable from the history of civilization**, dealing as it does with human efforts to raise productivity’ (Rosenberg, 1982)
 - Technology has ‘**revolutionized the structure of firms and households**’ (Mokyr 2002)
-
- ‘(...) the **Industrial Revolution** marked a major turning point in man’s history’ (Landes 2003) → Technological change has (...) ability to **induce short-term disruptions, which unveil long-term benefits** (Mokyr et al., 2015)

Before „technological revolution(s)”?

Pre-industrial economies = zero-sum systems

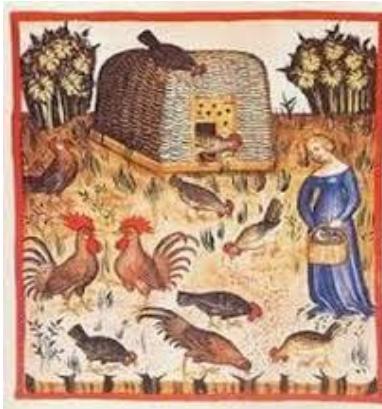
‘characterized by little or no economic growth which implies that upward social mobility only comes at expense of someone else’ (Granato et al. 1996)



Zero-Sum Game



Medieval societies made '*path-breaking inventions*' – paper / wind power; the impact of inventions on development was barely detectable, because technologies did not diffuse!



People in pre-1750s **had fun BUT were too poorly educated** to ensure expansion of technology → ***spread of technologies*** is as a critical factor in fostering long-term development.

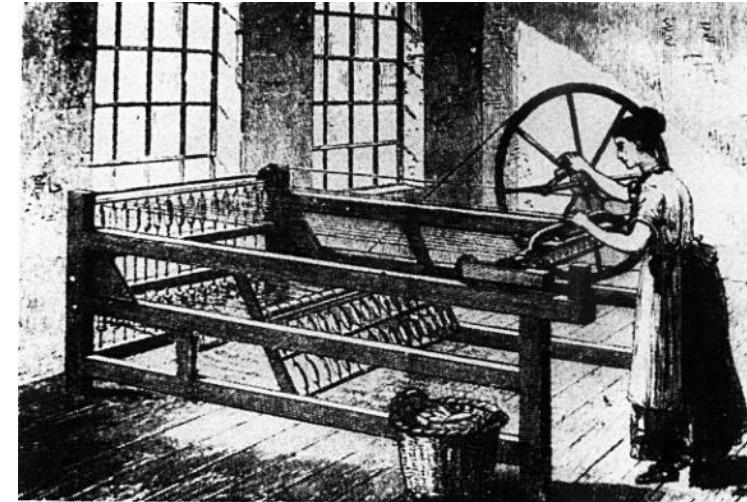
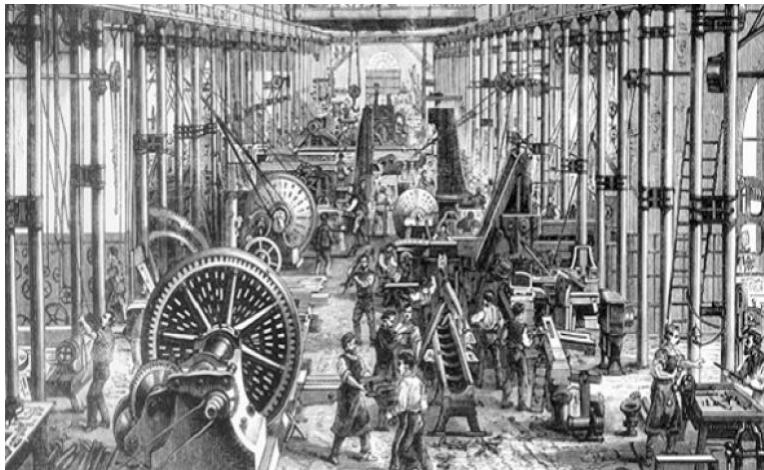
What is the Industrial Revolution?

- The Industrial Revolution was a period from the 18th-20th centuries where major changes in agriculture, manufacturing, mining, transportation, and technology had a profound effect on the social, economic, and cultural conditions of the time.

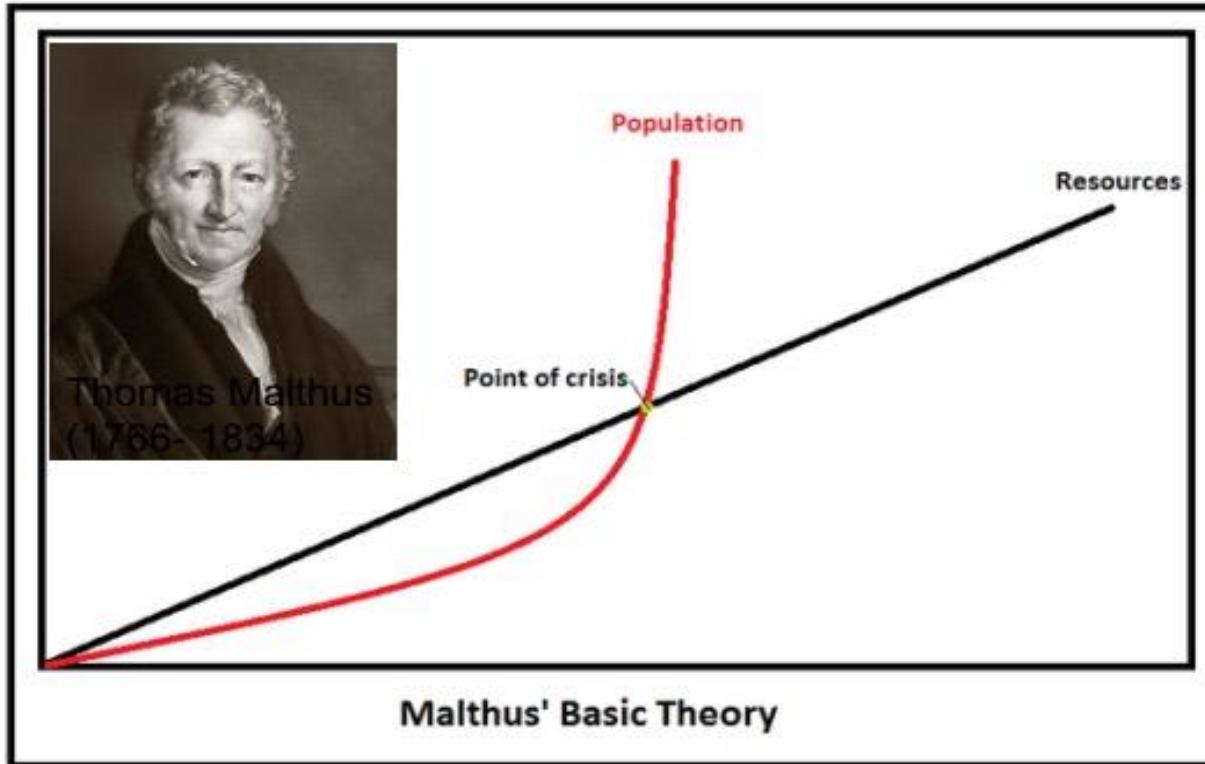


In XVIII the Industrial Revolution arrived and changed it all

*'by substituting machines for animal force, **gives birth to a modern economy'***
(Landes 2003)



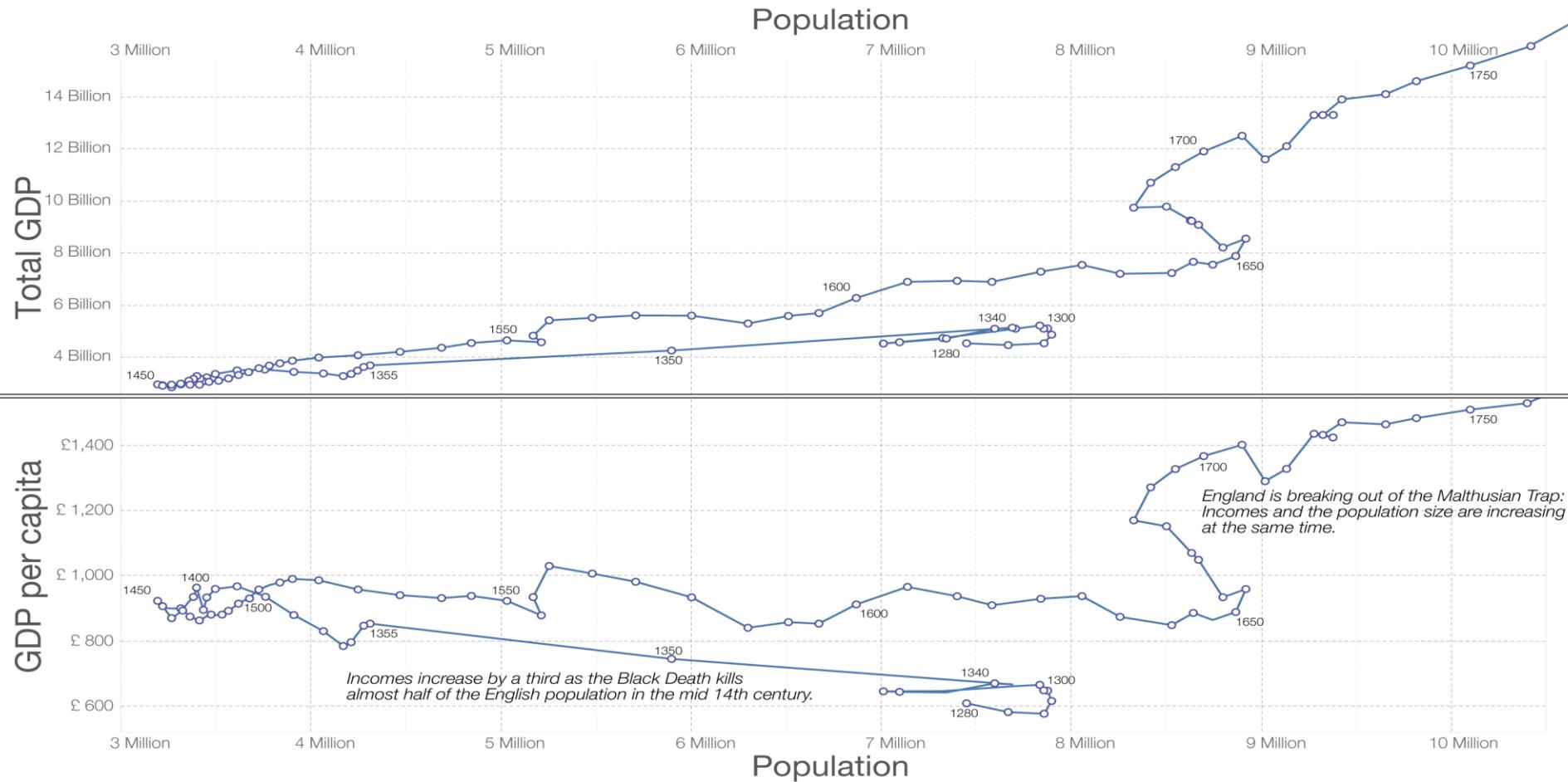
End of Malthusian Trap



The Malthusian Economy: GDP, GDP per capita, and the size of the population in England from 1280 to 1770

GDP is adjusted for inflation and expressed in 2013 prices.

Before sustained economic growth was achieved the English economy was trapped in a 'Malthusian Economy', productivity increases lead to population increases so that per capita the output did not increase. And vice versa, population decreases, such as the strong decline due to the plague in the mid-14th century, lead to increasing output per capita for those that survived the Black Death. For reference and in the same prices: GDP per capita in 2015 was £28,161 in the UK.



Data source: Broadberry et al and Bank of England. Data prior to 1700 refers to England; data thereafter refers to the UK. Averages over 5 year intervals are shown here.

The visualization is available at OurWorldInData.org where you find more visualizations and research on global development.

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FIVE SUCCESSIVE TECHNOLOGICAL REVOLUTIONS

Revolution	Name	Country	Initiation	Year
First	The 'Industrial Revolution'	Britain	Arkwright's mill	1771
Second	Age of Steam and Railway	Britain	The Liverpool-Manchester railway	1829
Third	Age of Steel, Electricity and Heavy Engineering	USA and Germany	The Carnegie Bessemer steel plant	1875
Fourth	Age of Oil, the Automobile and Mass Production	USA	Ford Model-T	1908
Fifth	Information/ Tele- communication	USA	The Intel Microprocessor	1971

Source: Carlota Perez, *Technological Revolutions and Financial Capital*

The Industrial Revolution brought rapid urbanization, or the movement of people to cities. Changes in farming, soaring population growth, and an ever-increasing demand for workers led masses of people to migrate from farms to cities.



The Industrial Revolution

Economic Effects

- New inventions and development of factories
- Rapidly growing industry in the 1800s
- Increased production and higher demand for raw materials
- Growth of worldwide trade
- Population explosion and a large labor force
- Exploitation of mineral resources
- Highly developed banking and investment system
- Advances in transportation, agriculture, and communication

Social Effects

- Long hours worked by children in factories
- Increase in population of cities
- Poor city planning
- Loss of family stability
- Expansion of middle class
- Harsh conditions for laborers
- Workers' progress vs. laissez-faire economic attitudes
- Improved standard of living
- Creation of new jobs
- Encouragement of technological progress

Political Effects

- Child labor laws to end abuses
- Reformers urging equal distribution of wealth (i.e. Karl Marx)
- Trade unions
- Social reform movements, such as utilitarianism, utopianism, socialism, and Marxism
- Reform bills in Parliament

World history in one picture

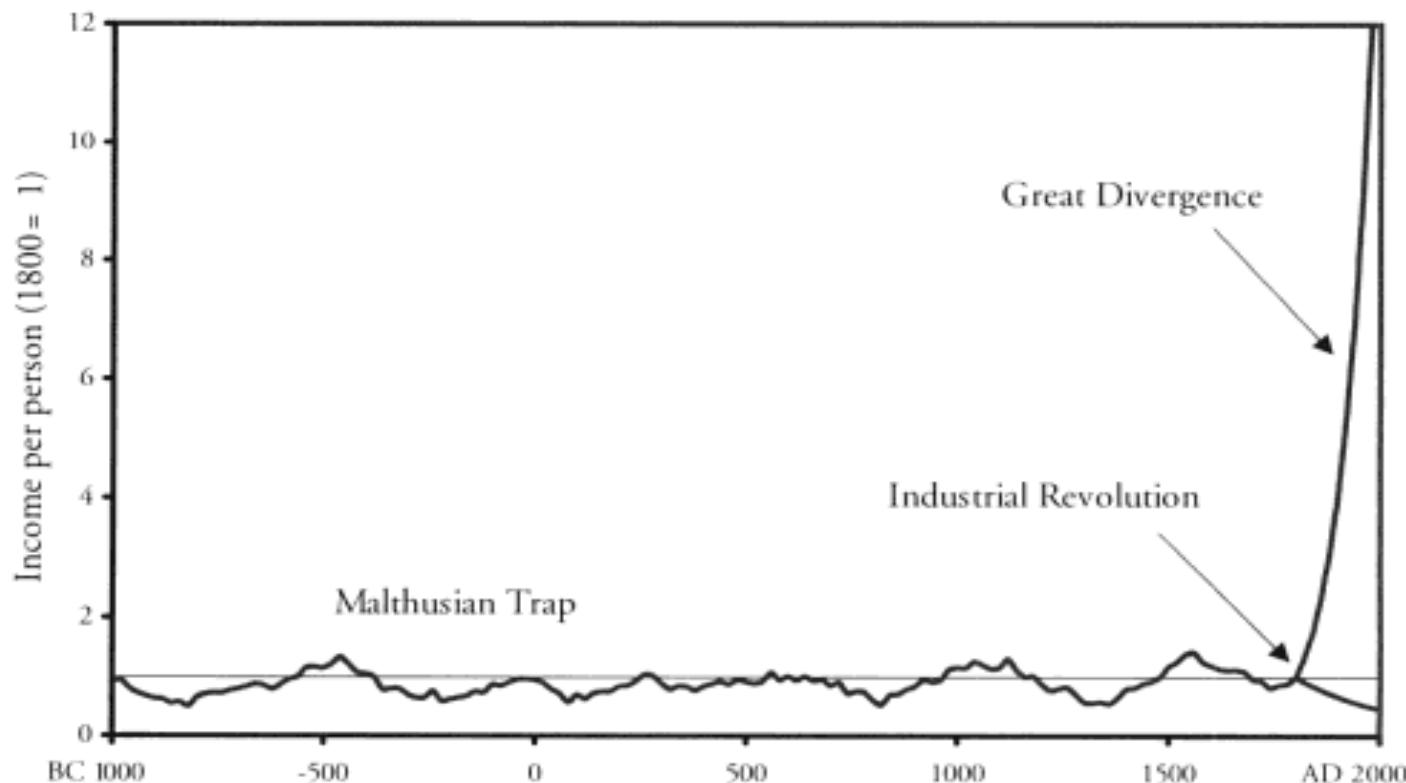
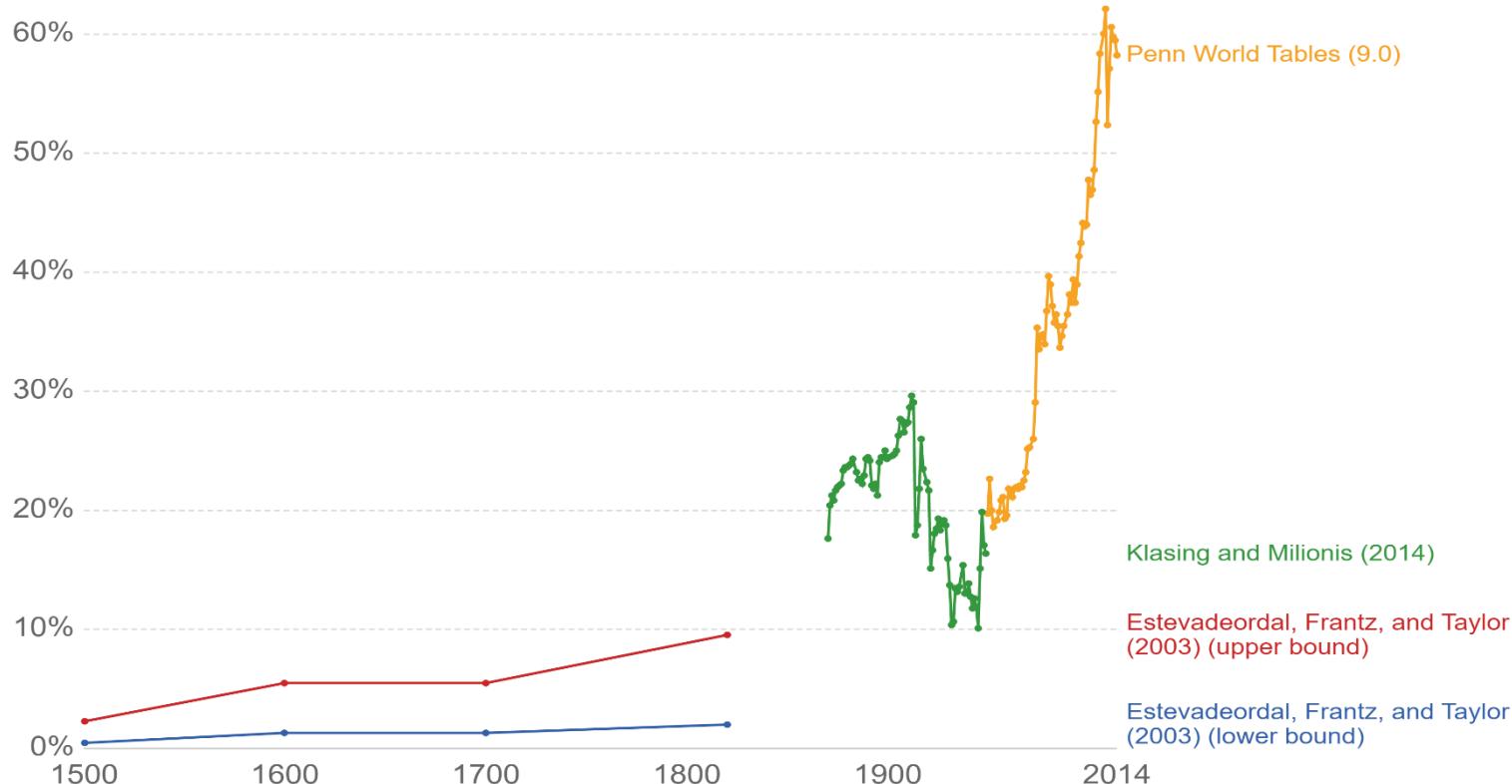


Figure 1.1 World economic history in one picture. Incomes rose sharply in many countries after 1800 but declined in others.

Globalization over 5 centuries

Shown is the "trade openness index". This index is defined as the sum of world exports and imports, divided by world GDP. Each series corresponds to a different source.



Source: Penn World Tables 9.0, Estevadeordal, Frantz, and Taylor (2003), Klasing and Milionis (2014)

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The size of the world population over the last 12.000 years

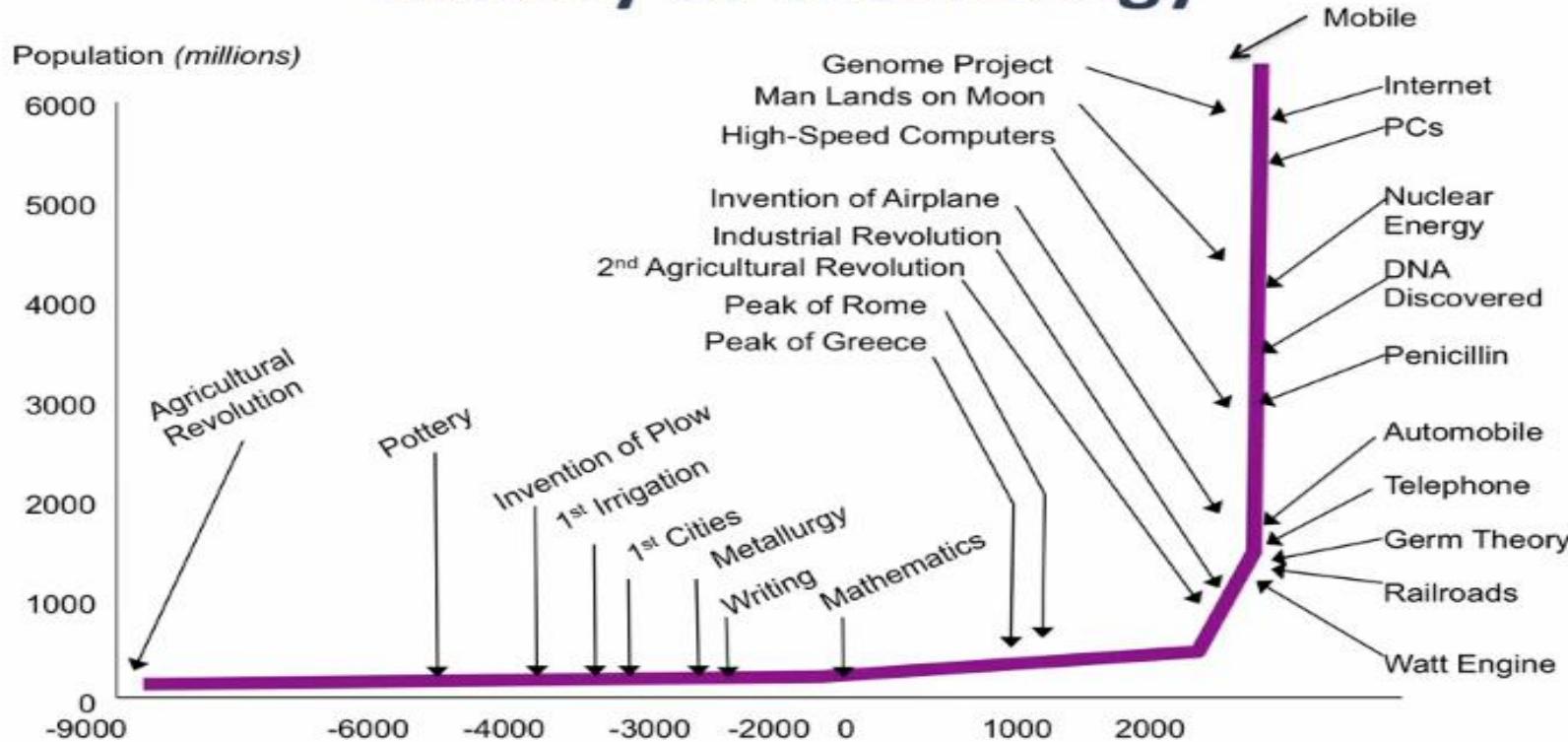


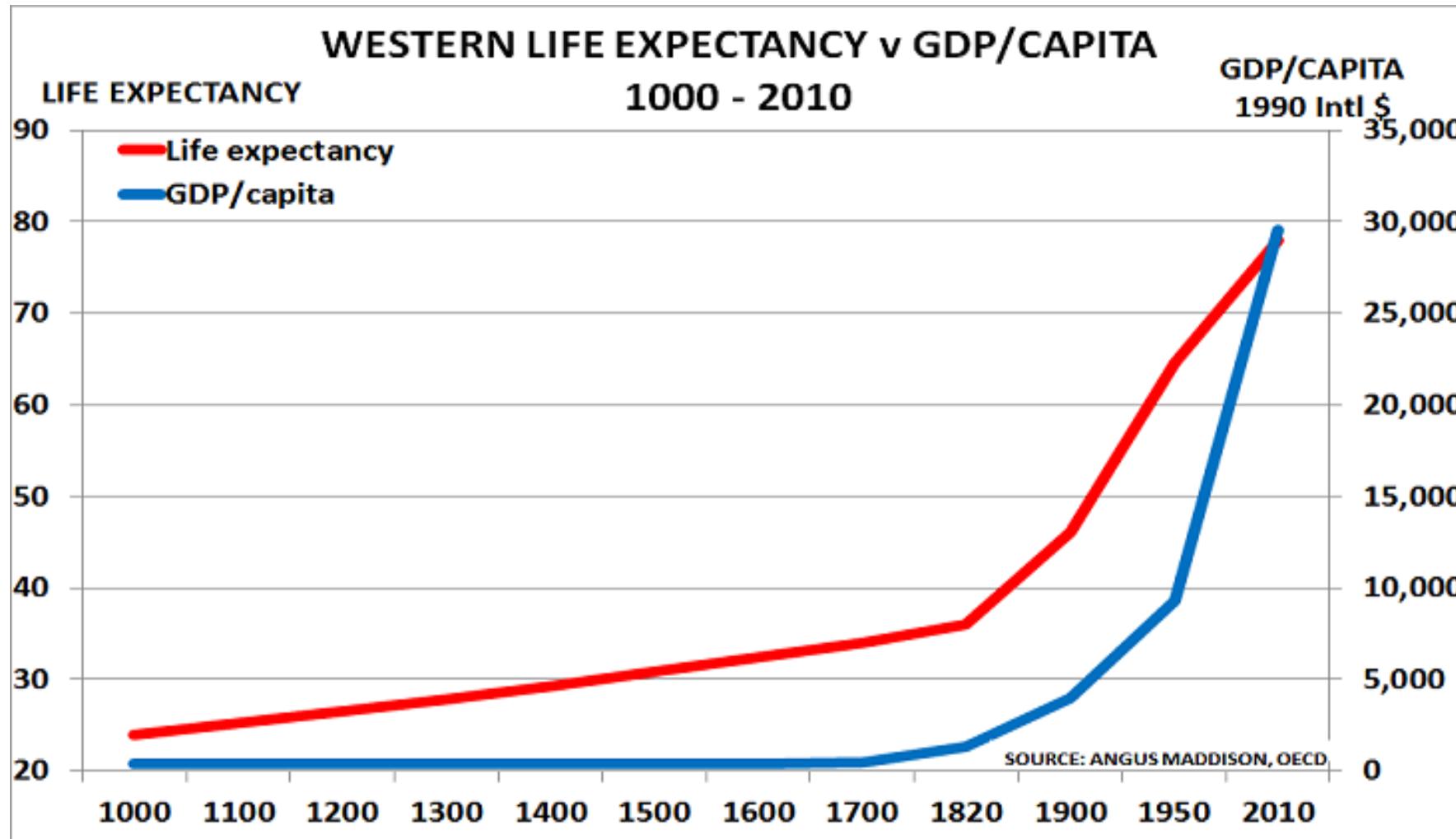
Based on estimates by the *History Database of the Global Environment* (HYDE) and the United Nations. On [OurWorldInData.org](#) you can download the annual data.

This is a visualization from [OurWorldInData.org](#), where you find data and research on how the world is changing.

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Growth of World Population and the History of Technology





The value of global exports

Time series of value of world exports at constant prices, relative to 1913 (i.e. values correspond to world export volumes indexed at 1913=100)

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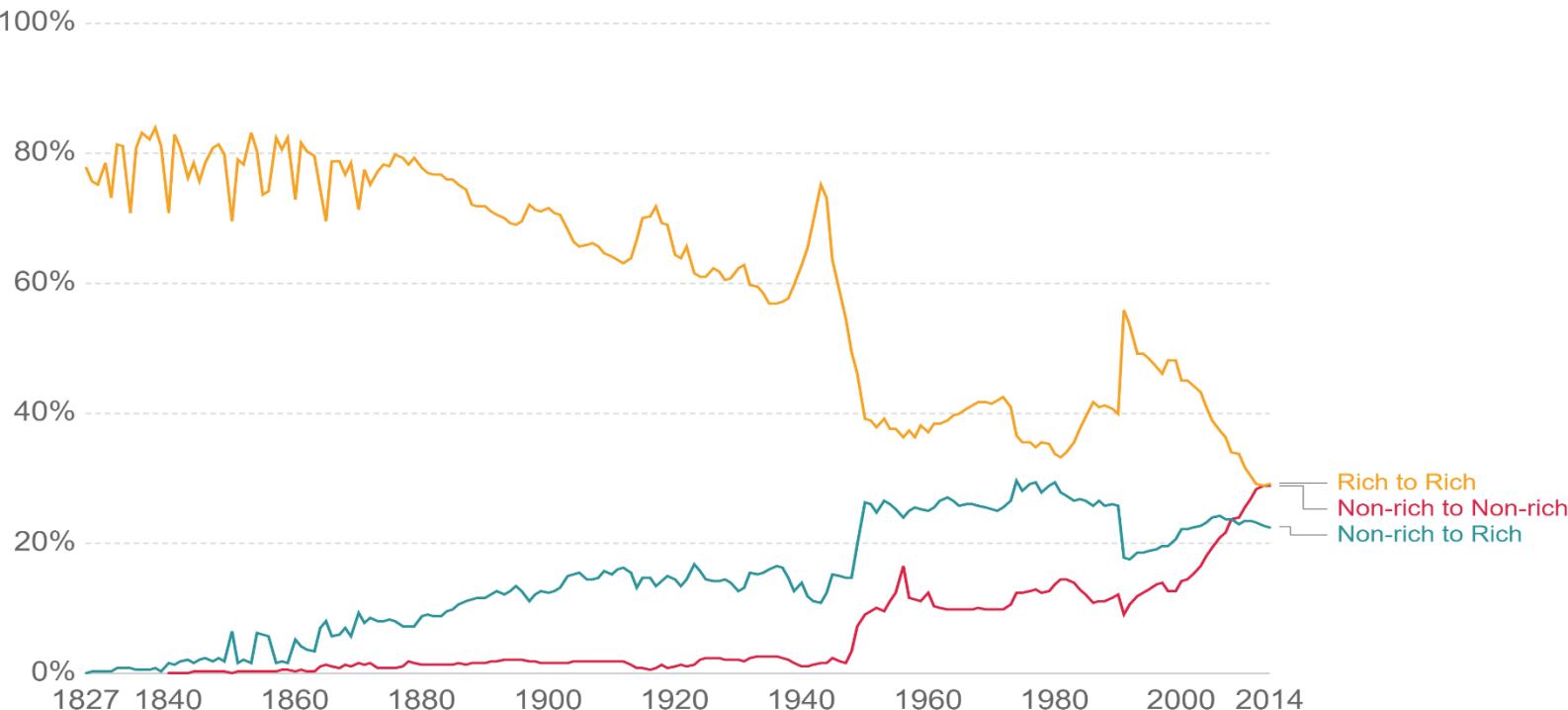


Source: Federico and Tena-Junguito (2016)

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Exports between rich and non-rich countries (% global exports)

The 'non-rich to rich' trade series shows the proportion of global merchandise exports that correspond to sales from non-rich countries to rich countries. The other series show similar flows within and across these countries. See the note at the bottom with the list of 'rich countries'.



Source: Fouquin and Hugot (CEPII 2016)

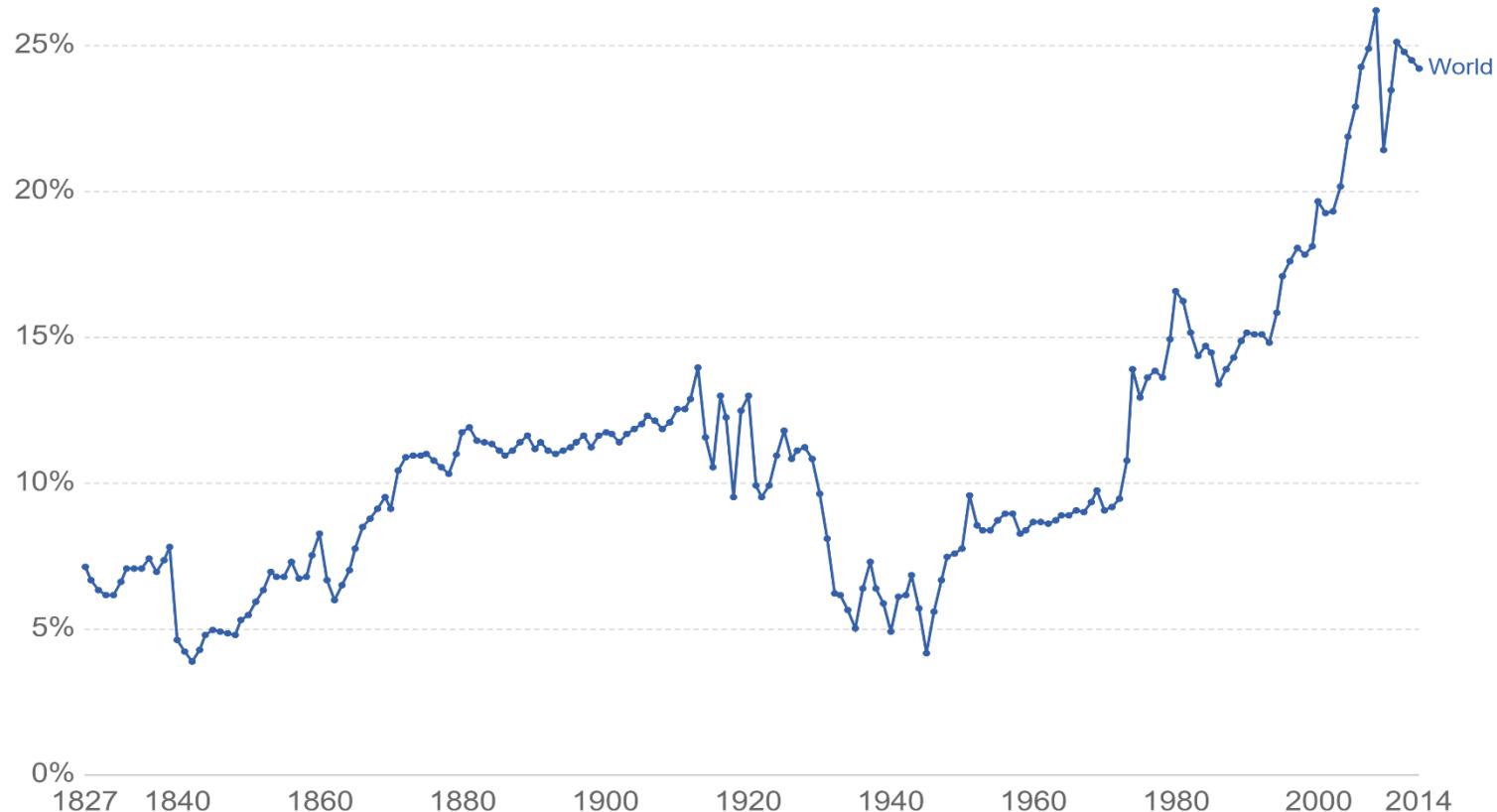
Note: The rich countries in this chart are: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States. 'Non-rich countries' are all the other countries in the world for which data is available.

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Value of exported goods as share of GDP

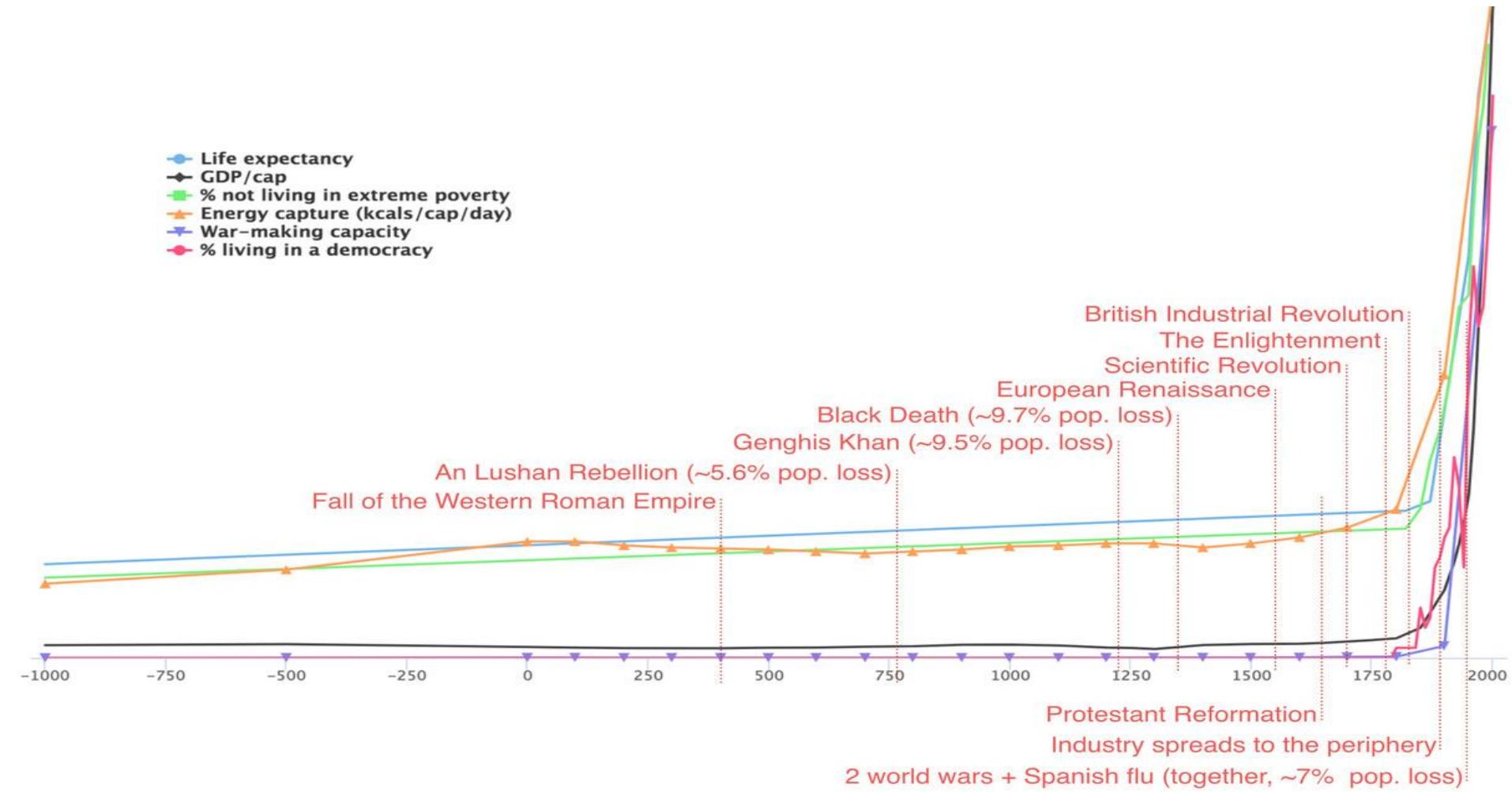
Estimates correspond to merchandise export-to-GDP ratios.

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Source: Fouquin and Hugot (CEPII 2016)

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Technology and infrastructure diffusion in the US, 1800 to 2003

The diffusion of technologies and infrastructure in the United States, measured in total production or adoption units.

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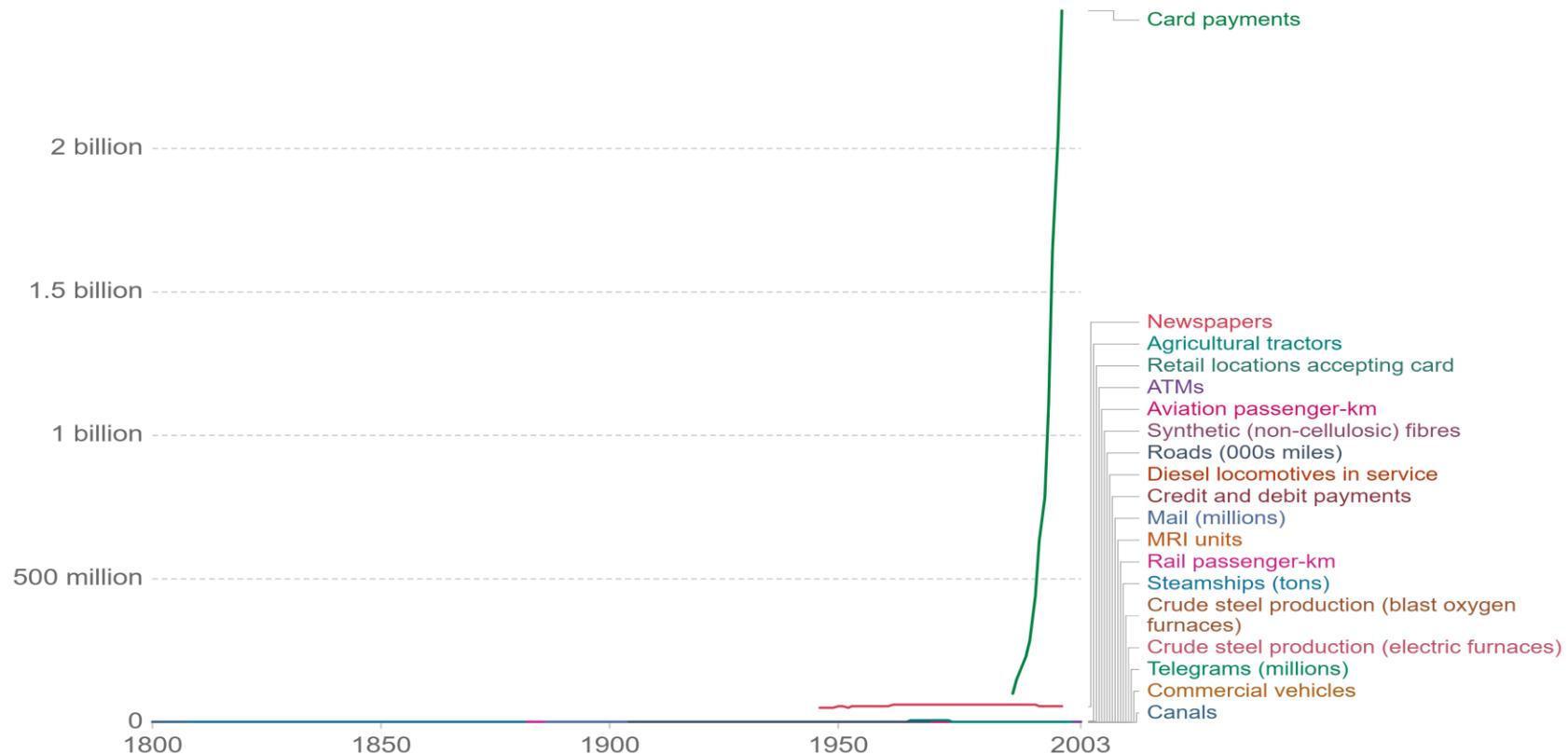


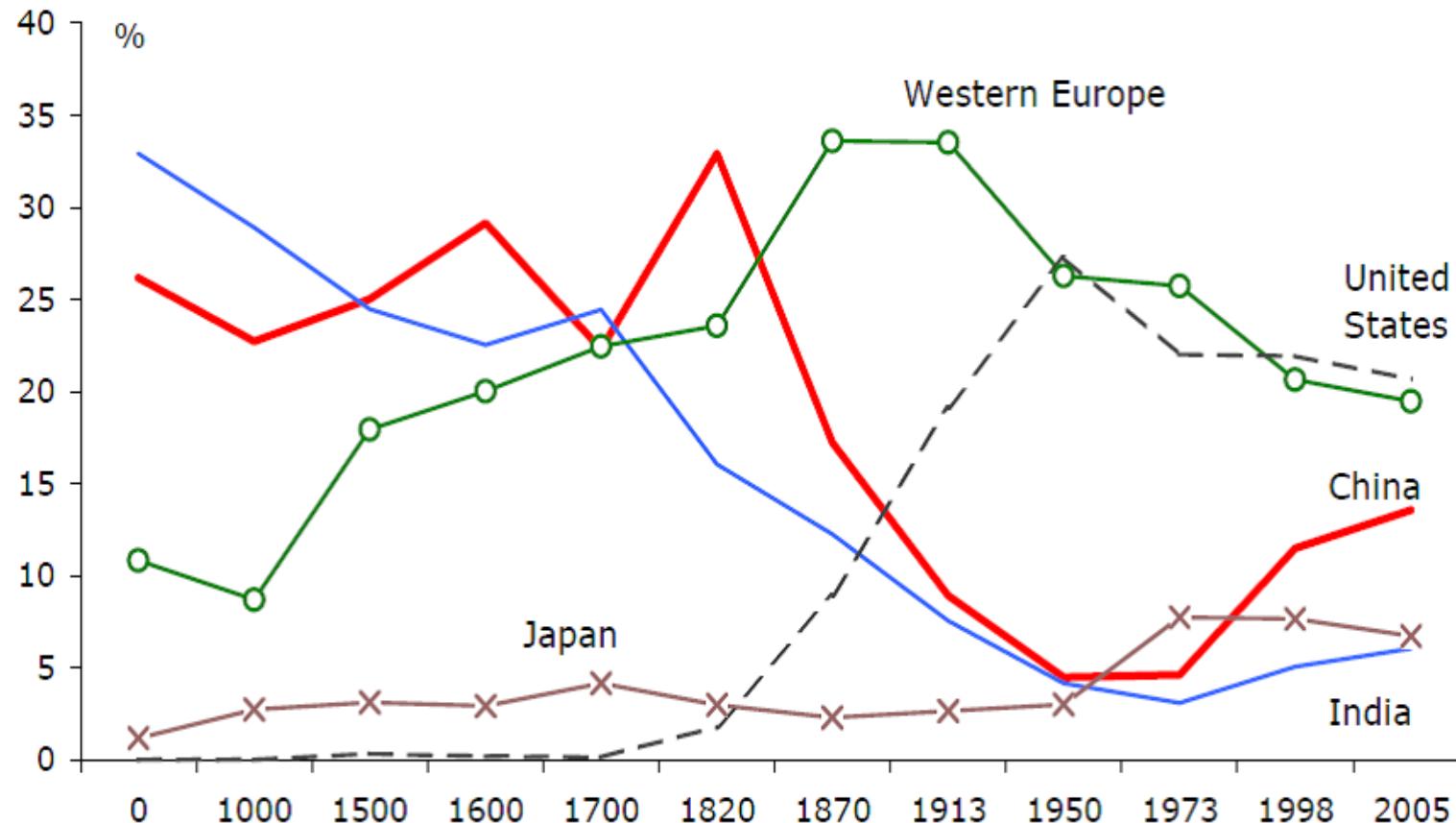
TABLE 2: HISTORICAL STATISTIC FOR THE WORLD ECONOMY
1000- 2003, per Capita GDP, (1990 international geary – khamis dollars)

Y e a r	1000	1500	1600	1700	1820	1850	1870	1880	1890	1900	1913	1920	1930	1940	1950	1960	1970	1980	1990	2000	2003
World	453	566	596	615	667	-	873	-	-	1262	1526	-	-	1962	2113	2775	3736	4521	5162	6055	6516
Afrika	425	414	422	421	420	-	500	-	-	601	637	-	-	813	890	1063	1355	1538	1449	1474	1549
Asia	470	568	574	572	581	-	556	-	-	638	696	-	-	897	717	1027	1531	2032	2784	3807	4434
13-E- Asia	-	-	-	-	580	-	549	-	-	610	679	-	-	-	668	959	1421	1868	2707	3781	4459
Lat- Am.	425	416	438	527	691	-	676	-	-	1113	1494	-	-	1933	2503	3129	3990	5440	5072	5893	5786
12- W.Eu.	425	798	907	1032	1243	1658	2087	2297	2643	3076	3688	3304	4288	4984	5018	7607	10959	14056	16870	20090	20596
US	400	400	400	527	1257	1806	2245	3184	3392	4091	5301	5552	6213	7010	9561	11328	15030	18577	23201	28403	29037

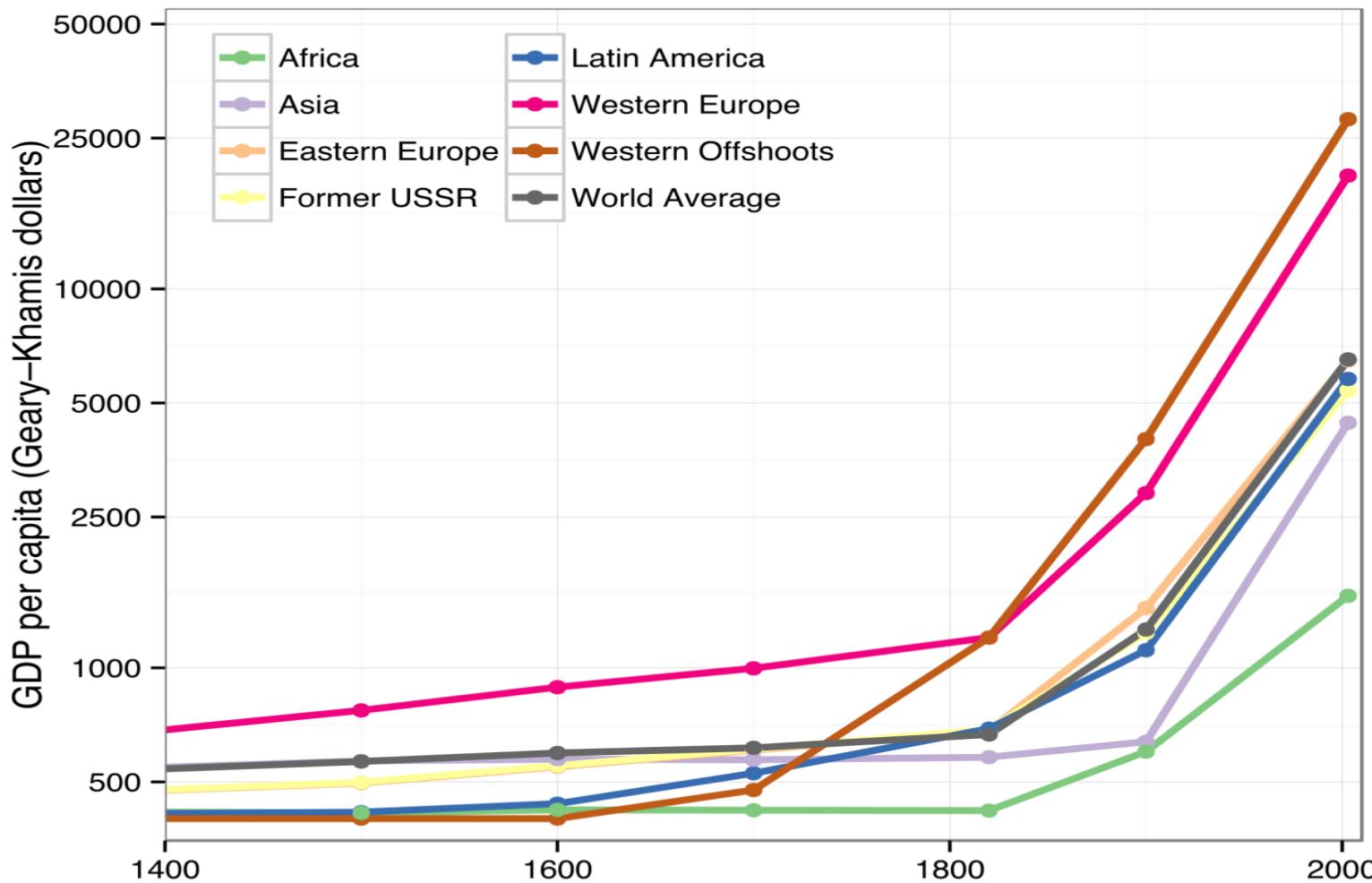
13-East-Asia: China, India, Indonesia, Japan, Philippines, S. Korea, Thailand, Taiwan, Bangladesh, Hong Kong, Malaysia, Pakistan, Singapore. Latin-America: All south American countries incl. Mexico and all south of Mexico situated countries and the Caribbean countries. 12- West Europe: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, UK

Source: Maddison, A. 2006. *The World Economy. Volume 2: Historical Statistics*. Paris: OECD.

Chart 1: Major economies' share of global GDP, 0 - 2005



Sources: Angus Maddison, *The World Economy: A Millennial Perspective*, OECD Development Centre, 2001; IMF, *World Economic Outlook Database*, 2005.



GDP per capita in England since 1270

Adjusted for inflation and measured in British Pounds in 2013 prices

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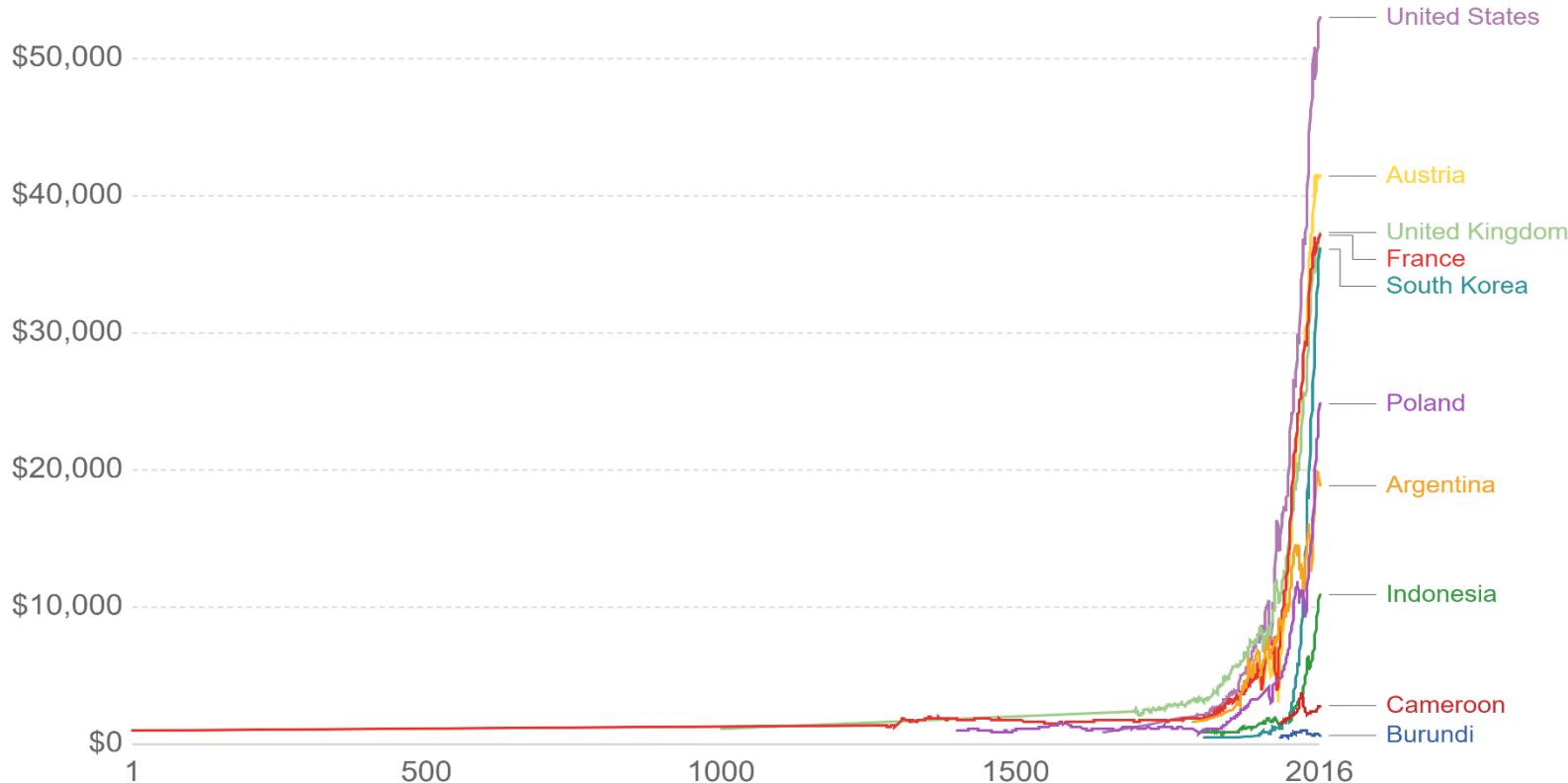
Source: Broadberry, Campbell, Klein, Overton, and van Leeuwen (2015) via Bank of England (2017)

Note: Data refers to England until 1700 and the UK from then onwards.

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GDP per capita

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

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in Data

Source: Maddison Project Database (2018)

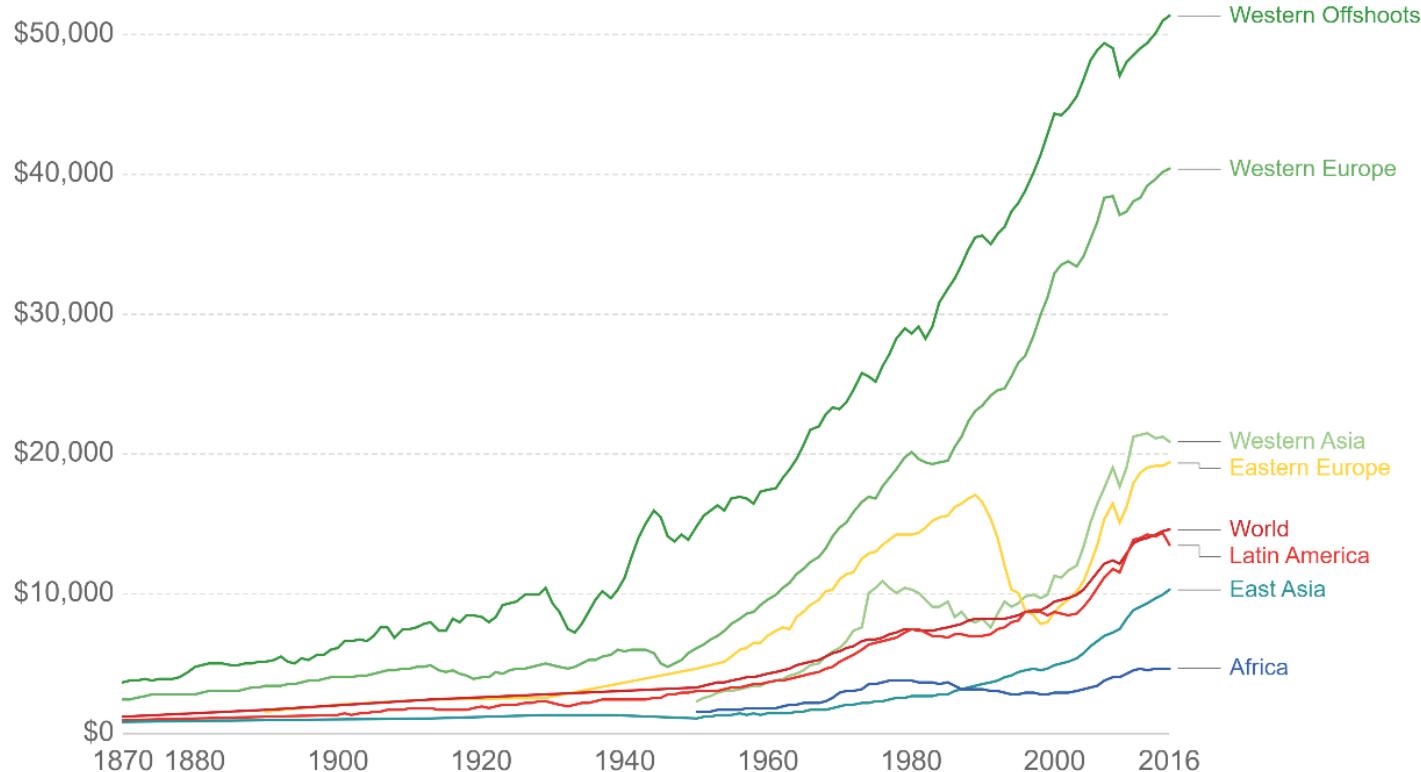
Note: These series are adjusted for price differences between countries based on only a single benchmark year, in 2011. This makes them suitable for studying the growth of incomes over time but not for comparing income levels between countries.

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Average GDP per capita across countries and regions

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

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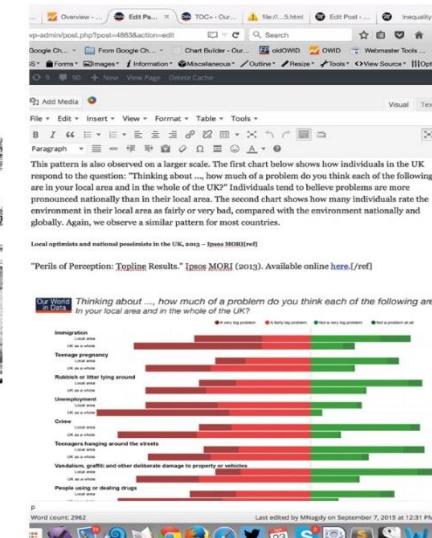
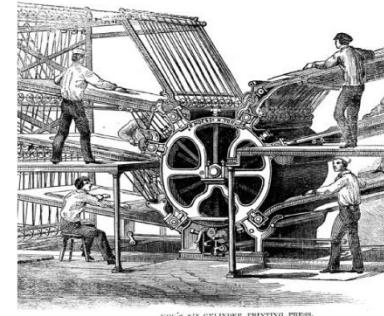
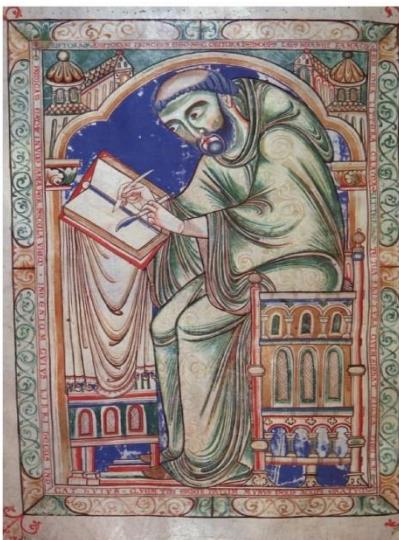
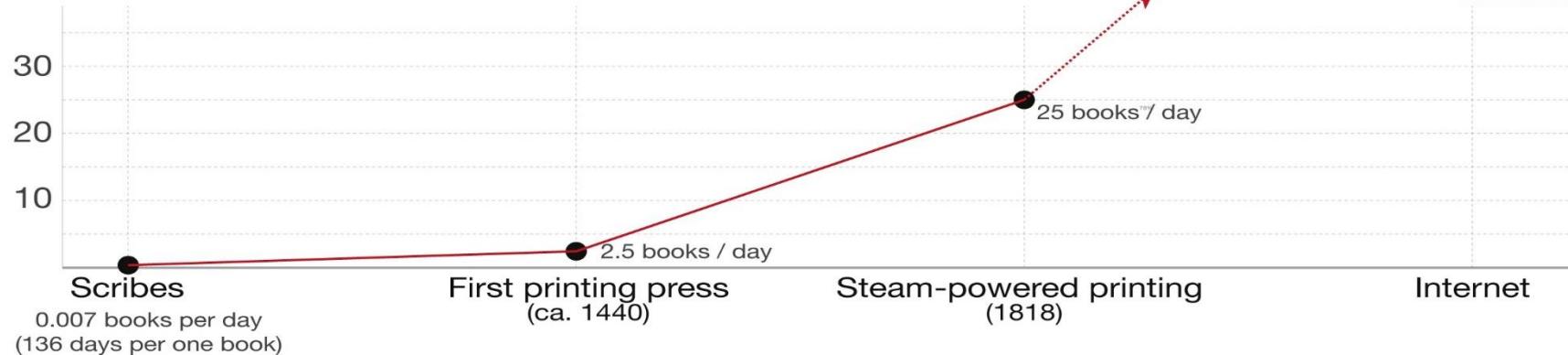


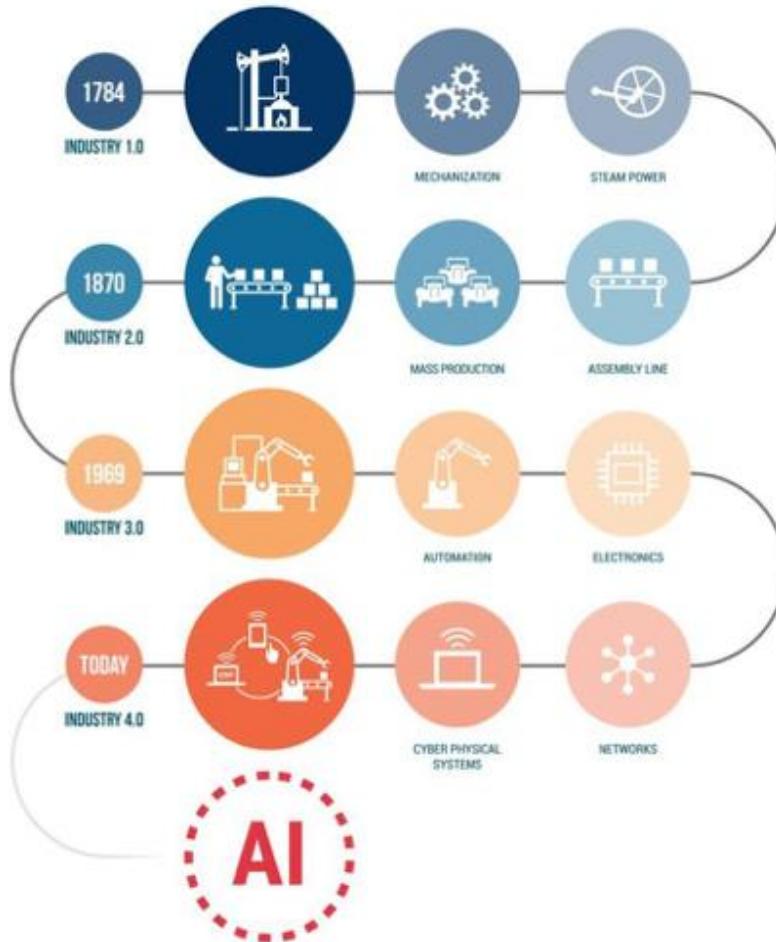
Source: Maddison Project Database (2018)

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.

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Over the last 6 centuries: How many books can you produce in one day?





AT THE CUSP OF THE 5TH INDUSTRIAL REVOLUTION

Recent rapid adoption and application of artificial intelligence algorithms – triggered by access to big data and better hardware-processing capabilities – are changing the face of blue and white collar jobs.

5th Technological Wave – ICT

- Since 1971 first microprocessor in Santa Clara
- ICT - *General Purpose Technologies*
- ICT are *disruptive, pervasive and radical innovations*
- ICT bring sth new to society and economy = new products, services, branched, professions, change structures, ways of communication, *create networks and mobilize resources*



THE EVOLUTION OF TECHNOLOGY & Its Impact on the Development of Social Businesses



We are babies.

1960s

Technology has **little impact**.
It is a curiosity.

The company is king, but a benevolent king. Good focus on customer satisfaction, but customers have few options. Communications makes global business difficult so customers make geographic-based decisions.



We are still children.

1970s

Technology is for academics and has **little impact**.

Greater focus on margins and revenue. Customers become concerned about monopolies as customer satisfaction has less importance.



We are still children,
but we can pout to
get what we want.

1980s

Technology invades the home and starts to **change behaviors**.

Customers become increasingly concerned about company practices and lack of customer satisfaction. Communications have improved to help customers make more informed decisions and to have better choices.



Like teenagers, we now have some control but don't know what to do with it yet.

1990s

Technology is now everywhere. A great leap forward. It begins to **connect us** around the globe.

e-Commerce helps give customers a greater - and more informed - range of decisions. Companies use the web to make themselves more accessible but haven't begun truly focusing on customer relationships.



We are growing up, and
feeling pretty cool about it.

2000s

Technology enables more seamless communications across the globe. Growth is **explosive**, but like "explosions" is uncontrolled - all over the place.

Social Media allows customers to articulate their satisfaction with companies and make decisions based on the company's behavior, not just on price alone. Companies begin to react and change.



Welcome to adulthood!

2010s

Technology becomes **fully integrated** into our daily lives. We live more fully in a digital world.

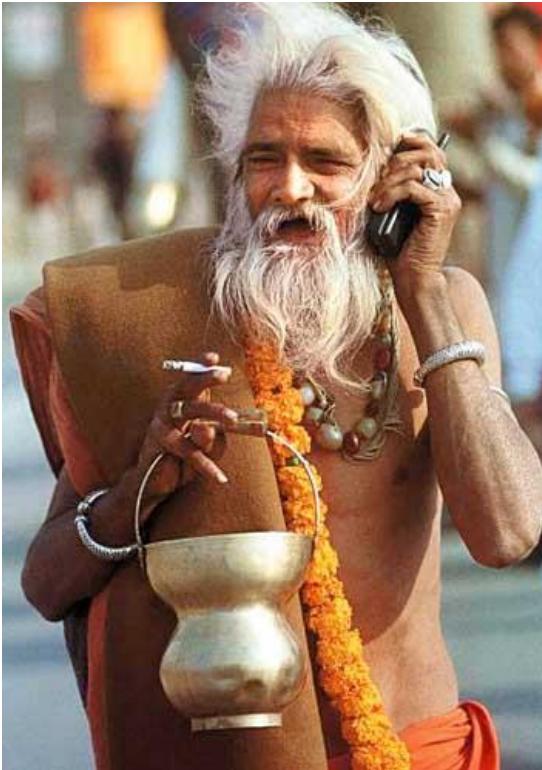
Social Businesses are the evolution of companies now keenly aware that how they act and how they engage with customers can be more important than price, that the relationship is part of the value. Companies allow greater transparency into all aspects of the company and use social media channels to effectively engage with customers, but with a focus on **WHAT** the customer wants and **HOW** best to deliver it to the customer.

What is so special about ICT?

- Are easy to use
(for unskilled/illiterate)
- Cheap, zero-marginal cost
(for low-income people)
- Fast distributable and easily instalable
- ,Omit' geographical and infrastructural barriers
- Perfect for backward economies
- Spread extremely fast

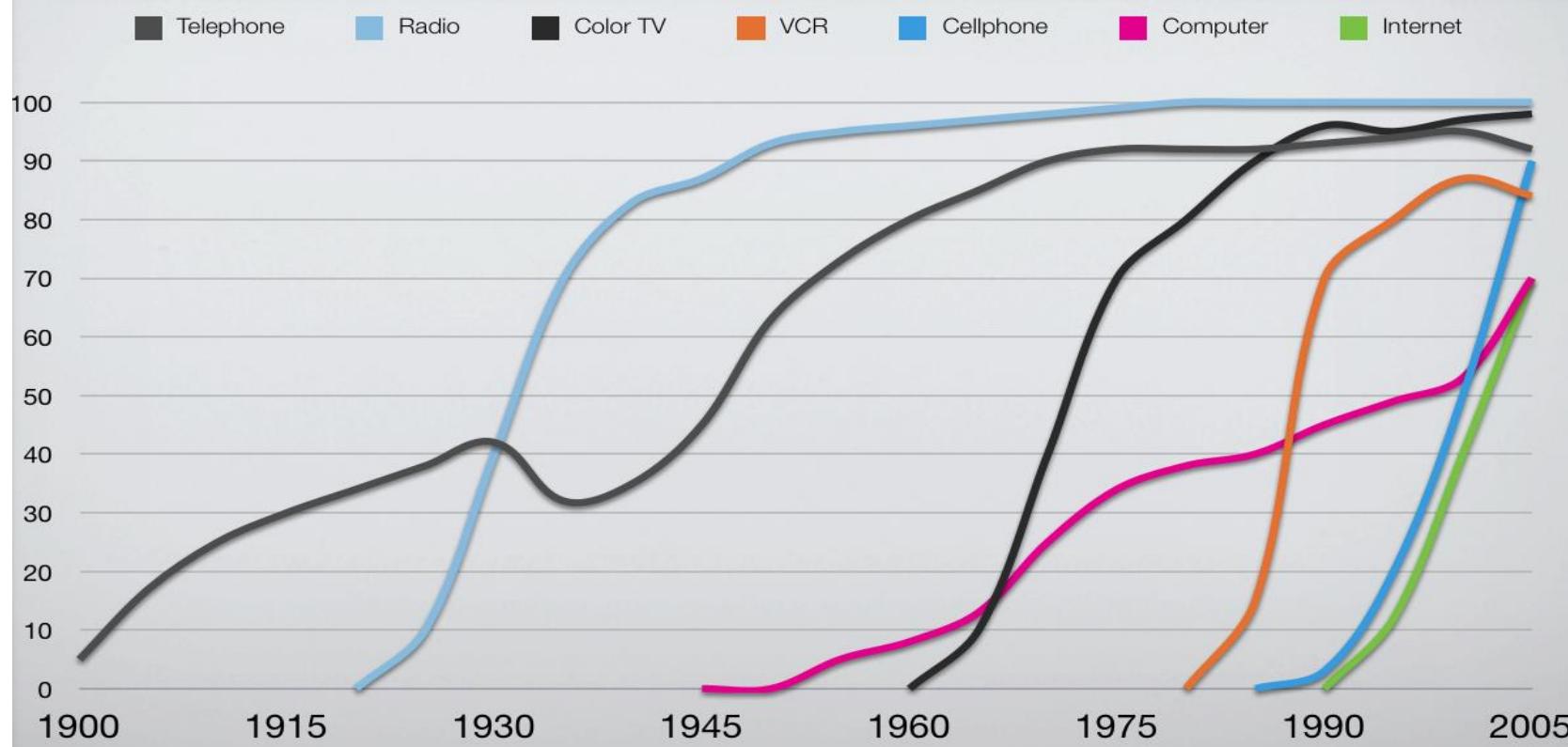


ICT spread literally everywhere



Tech Adoption

Historical adoption rates of communication technologies



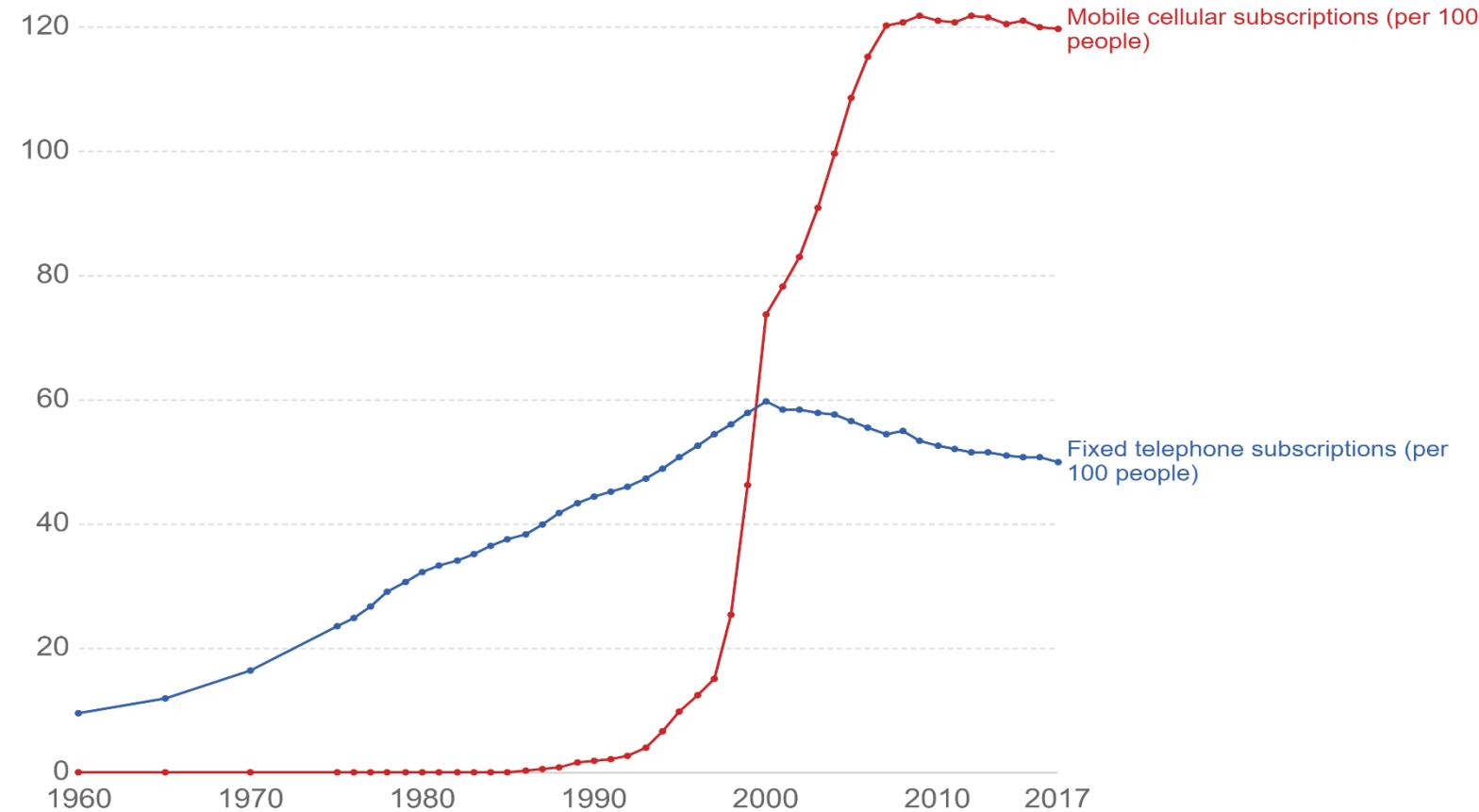
Best/worst mobile-telephony performers in 2022

Macao, China	332,0
Hong Kong, China	233,9
Maldives	222,9
Bahrain	216,9
United Arab Emirates	204,0
Jordan	196,3
Antigua & Barbuda	194,1
Thailand	172,6
Panama	172,3
Montenegro	167,4
Austria	166,1
Russian Federation	163,2
Seychelles	161,2
Trinidad & Tobago	160,6
Costa Rica	159,2
Oman	159,2
Botswana	158,5
Cayman Islands	157,6
Turkmenistan	157,6
Saudi Arabia	157,6

Sudan	68,6
Cameroon	68,1
Yemen	67,1
Guyana	66,4
Mozambique	66,2
Equatorial Guinea	65,9
Belize	63,8
Haiti	60,5
St. Helena	60,3
Somalia	58,1
Comoros	57,6
Lao P.D.R.	55,3
Angola	55,2
Uganda	55,1
Kiribati	51,3
Ethiopia	50,5
Niger	48,8
Papua New Guinea	48,5
Burundi	48,1

Mobile and fixed landline telephone subscriptions, United Kingdom

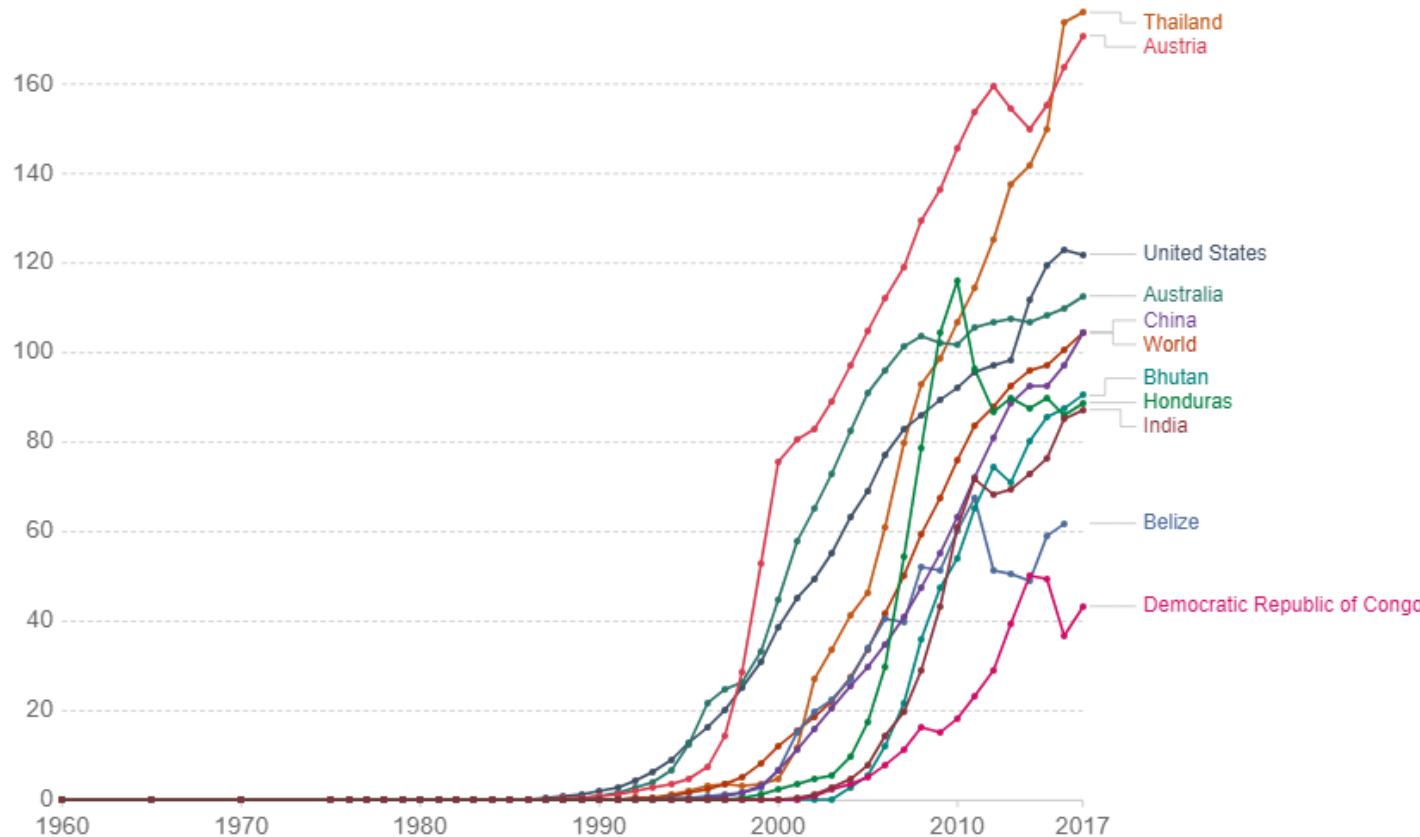
The number of fixed landline telephone and mobile cellular phone subscriptions, measured per 100 people.



Mobile cellular subscriptions, 1960 to 2017

Mobile phone subscriptions, measured as the number per 100 people.

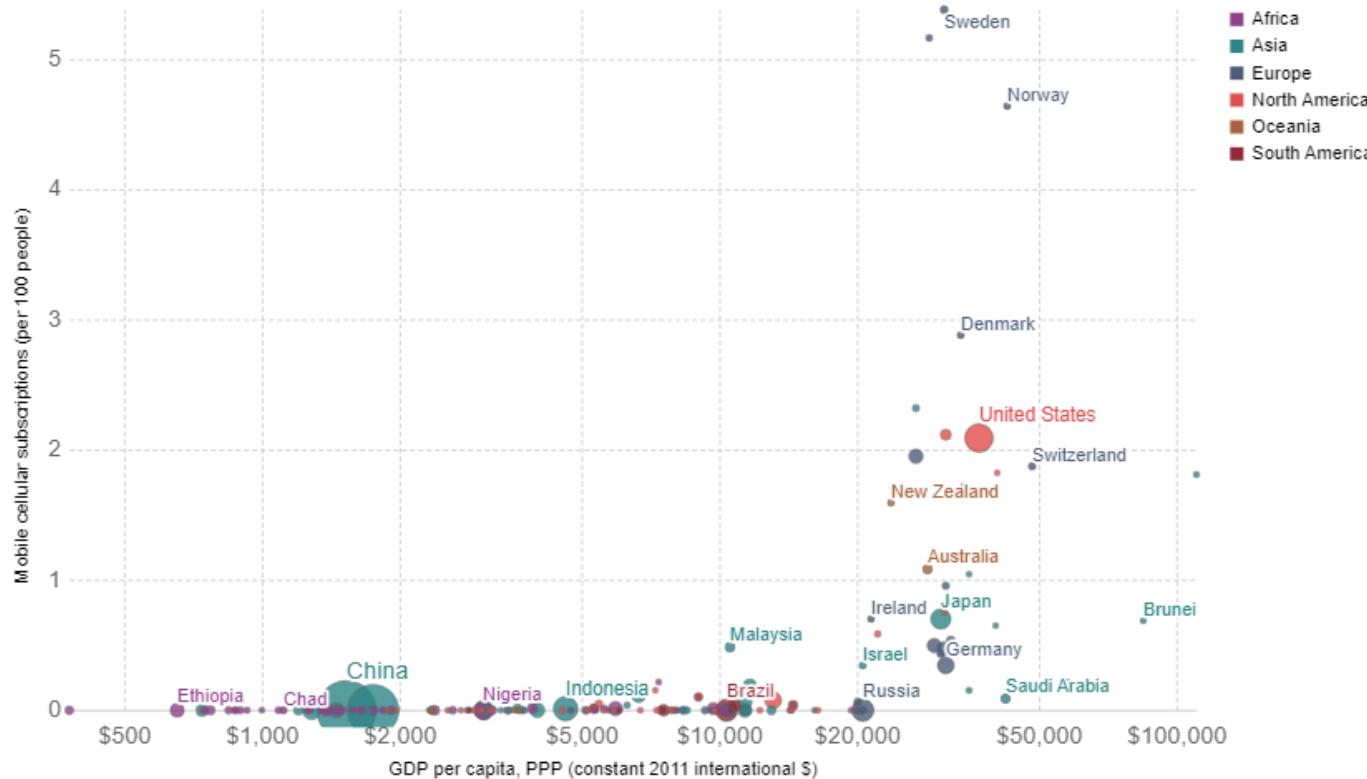
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Mobile phone subscriptions vs. GDP per capita, 1990

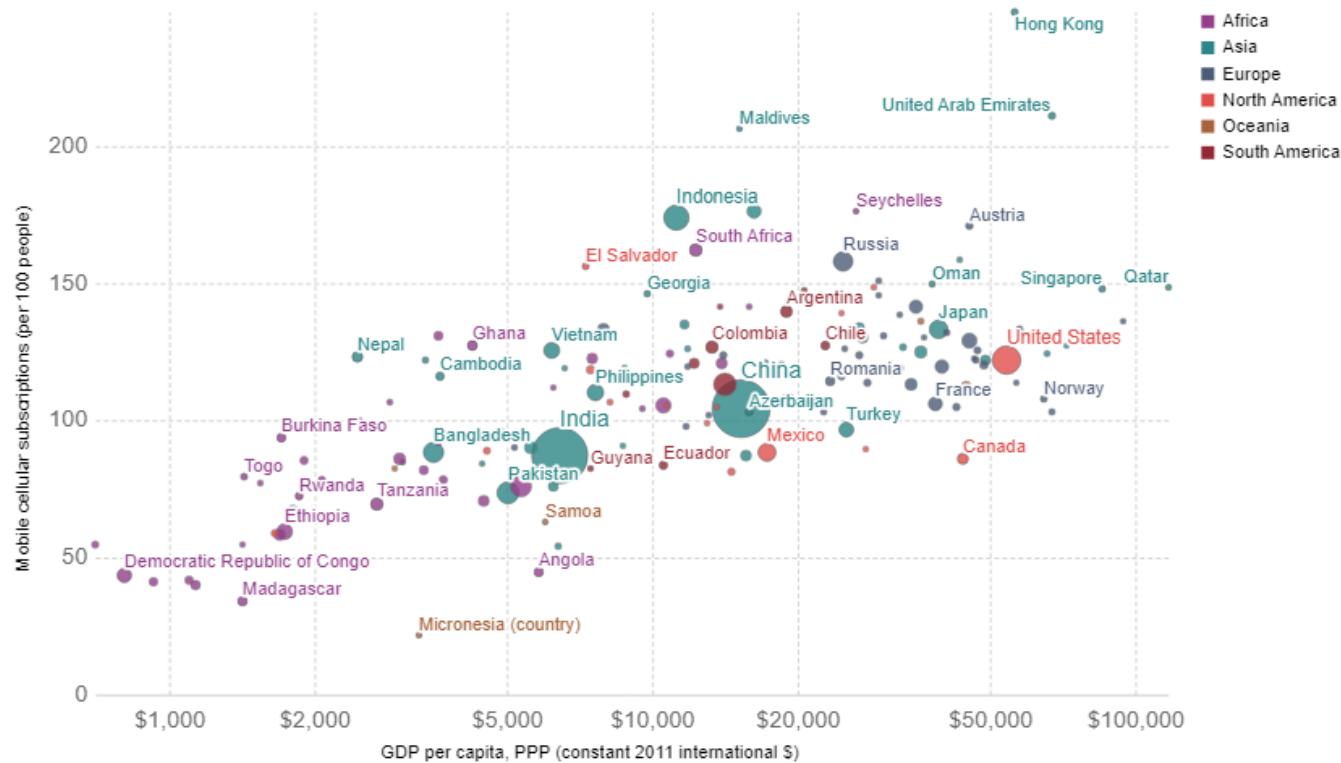
Number of mobile phone subscriptions, measured per 100 people versus gross domestic product (GDP) per capita, measured in 2011 international-\$.

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Mobile phone subscriptions vs. GDP per capita, 2017

Number of mobile phone subscriptions, measured per 100 people versus gross domestic product (GDP) per capita, measured in 2011 international-\$.

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Share of the population using the Internet, 1990

All individuals who have used the Internet in the last 3 months are counted as Internet users. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.

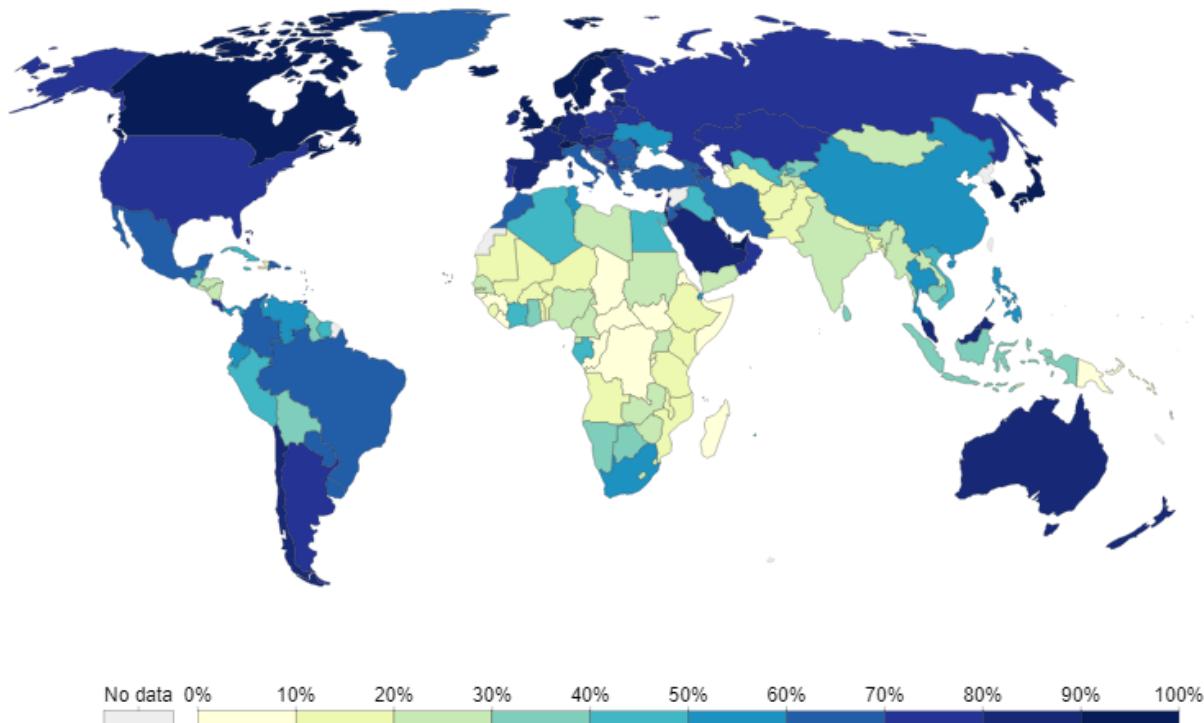


Source: World Bank

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Share of the population using the Internet, 2017

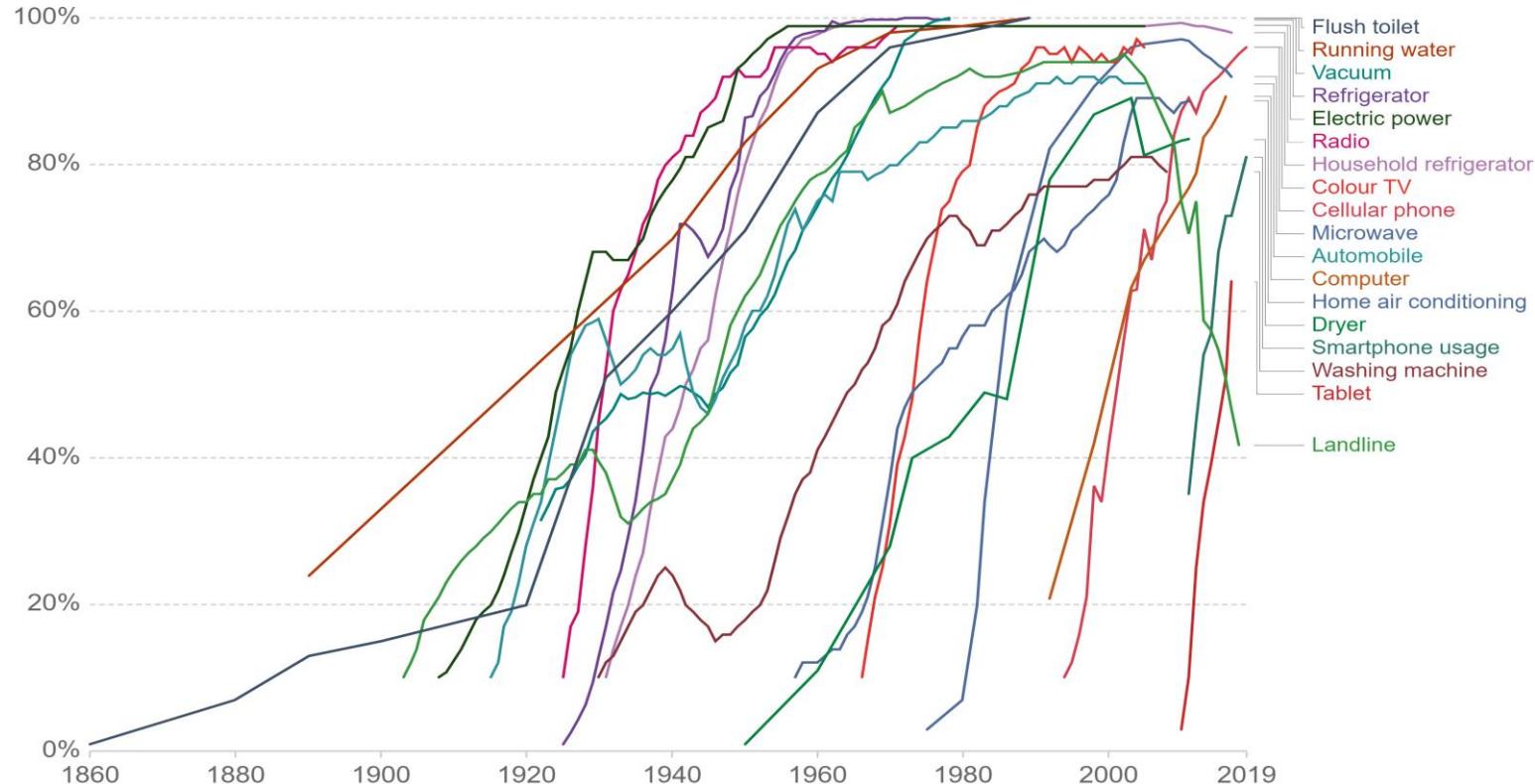
All individuals who have used the Internet in the last 3 months are counted as Internet users. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.

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Source: World Bank

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Share of US households using specific technologies, 1860 to 2019

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Source: Comin and Hobijn (2004) and others

Note: See the sources tab for definitions of adoption rates by technology.

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Consequences?

- Financial markets – new innovative financial products, eg. ETFs
- Financial markets digitalization / robo-advising / electronic markets
- Labour markets – polarization, new jobs, „jobs disappearance”, automation of production, new (digitally-oriented) skills and professions; **enhances radical shifts on labor markets – both on supply and demand side**
- Technological (un)employment
- Trading aspects
- Productivity paradox
- Changing patterns and structure of consumptions

Hard to quantify; (in)direct determinants/effects are hardly tracable

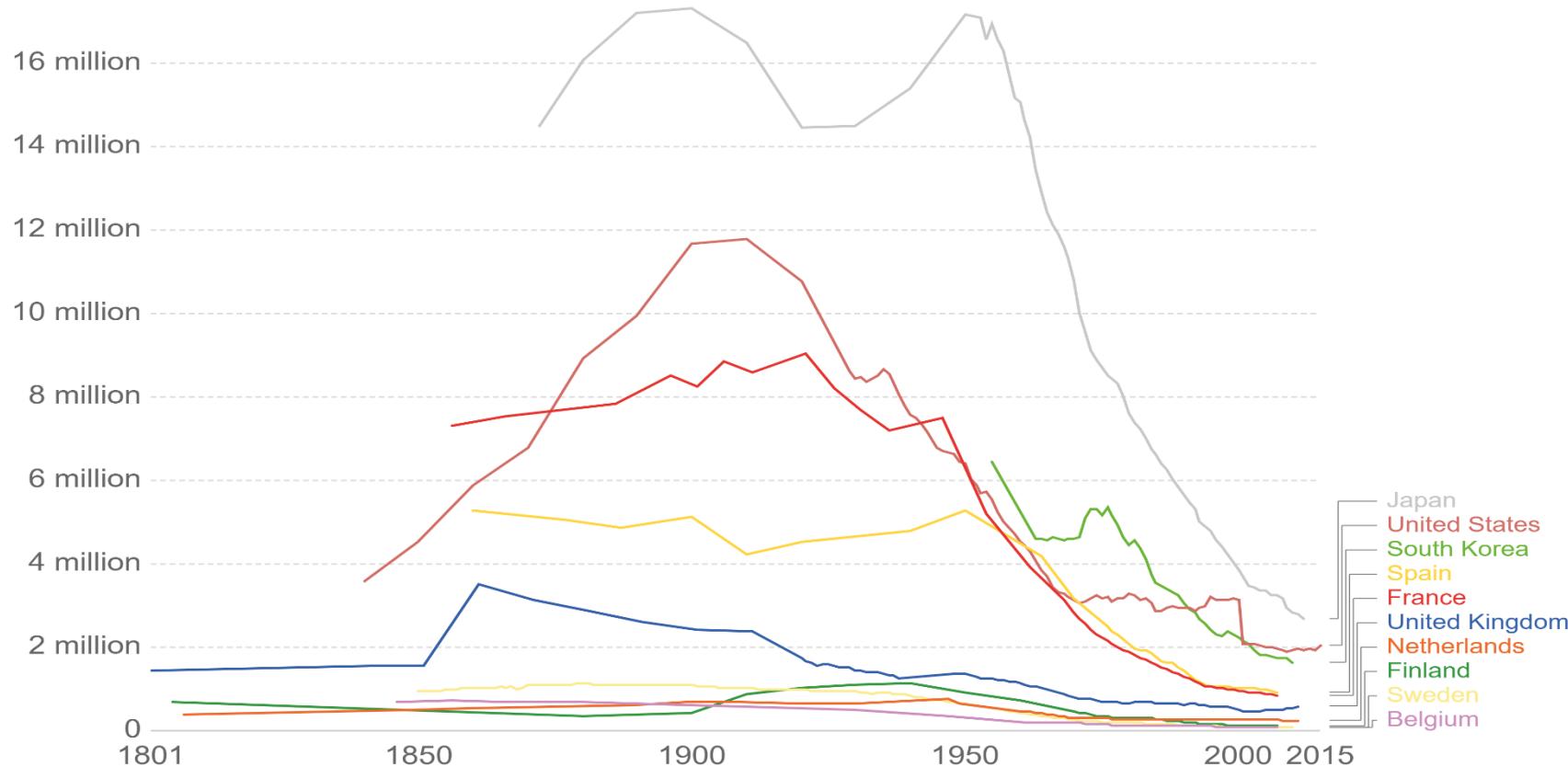
„wait and see attitude” (David, 1989)



Number of people employed in agriculture since 1800

The total number of individuals in agricultural employment across select countries from the year 1800.

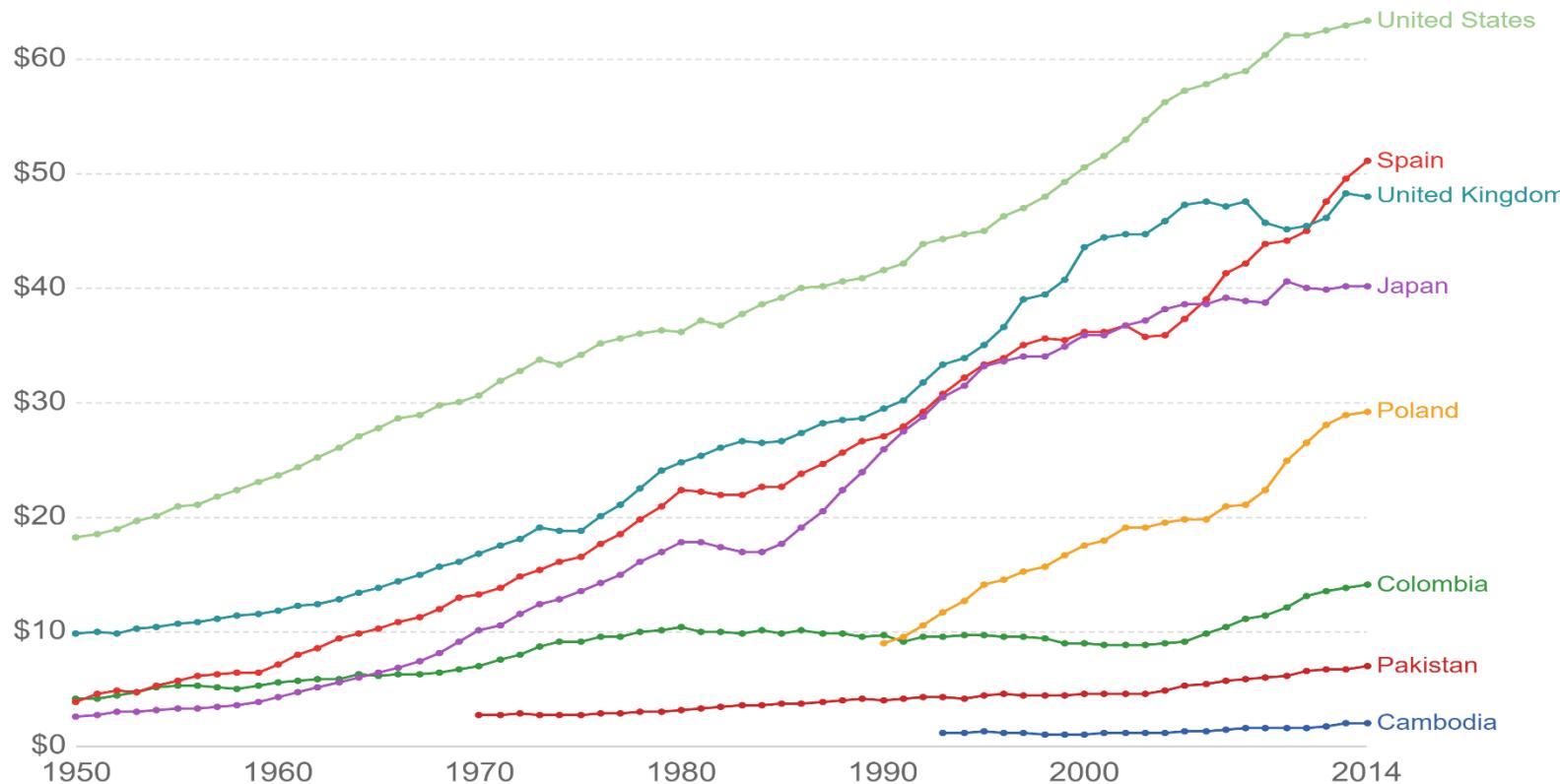
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Labor productivity – Output per hour worked

Output in \$ is adjusted for price differences between countries (PPP adjustment) and for price changes over time (inflation)

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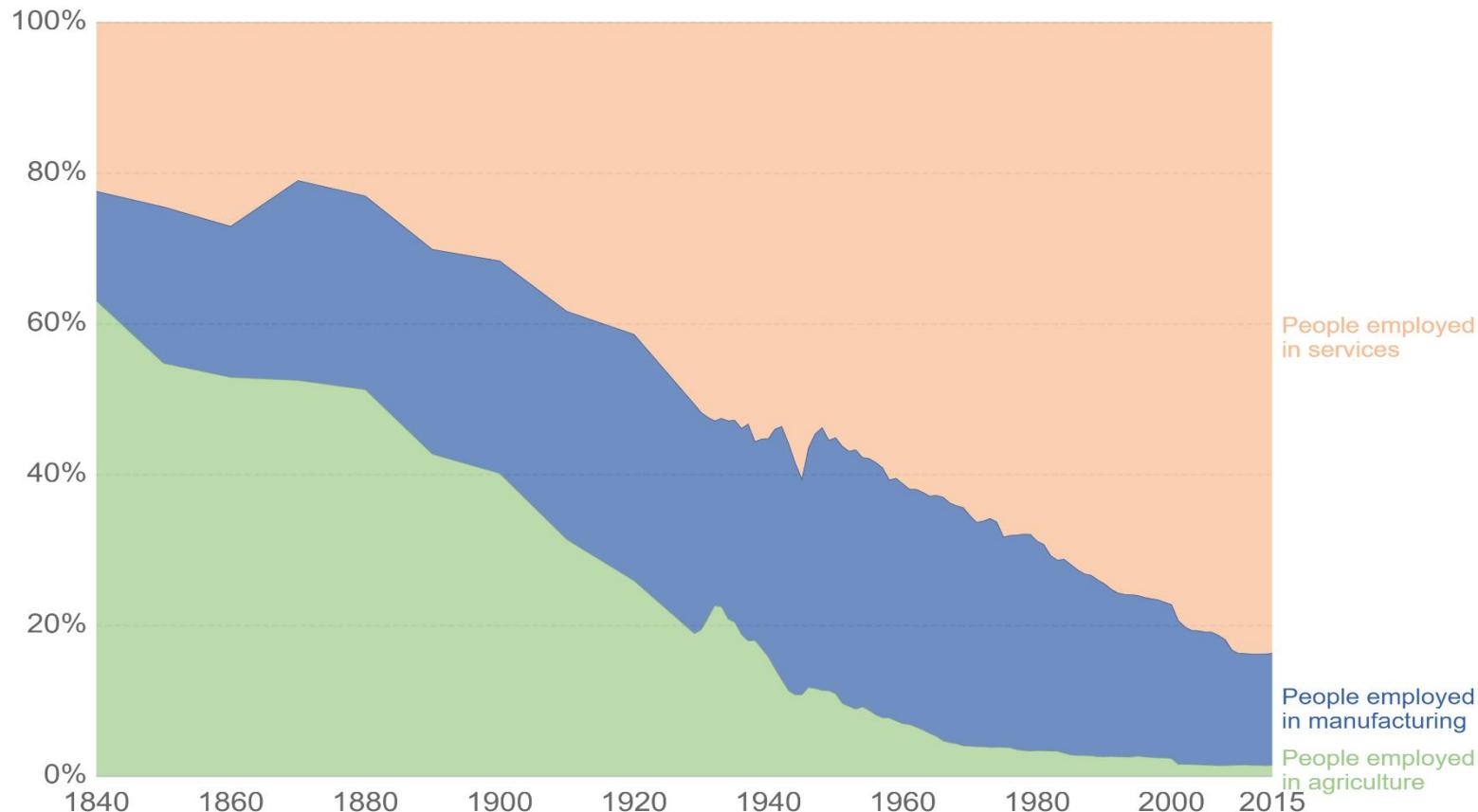
Source: Penn World Table 9.0 - OWID's team calculations

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Employment by economic sector, United States

Number of people employed by economic sector.

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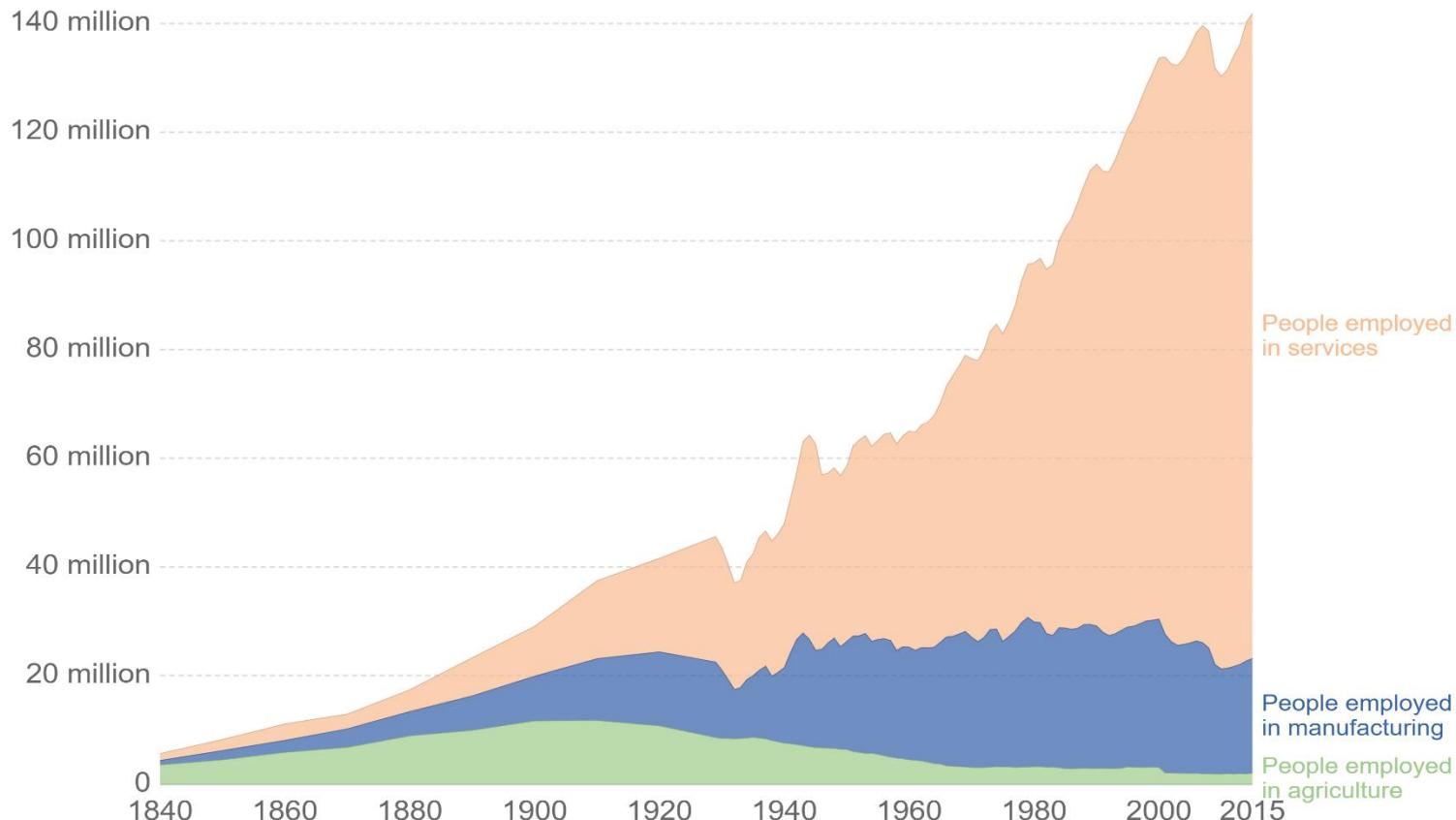
Source: Our World In Data based on Herrendorf et al. (2014)

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Employment by economic sector, United States

Number of people employed by economic sector.

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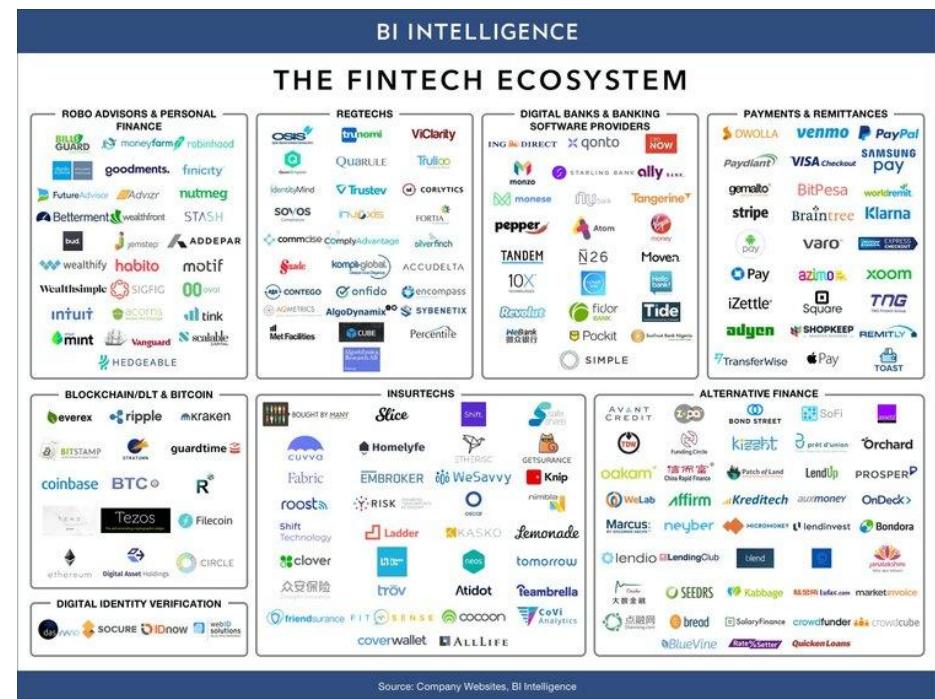


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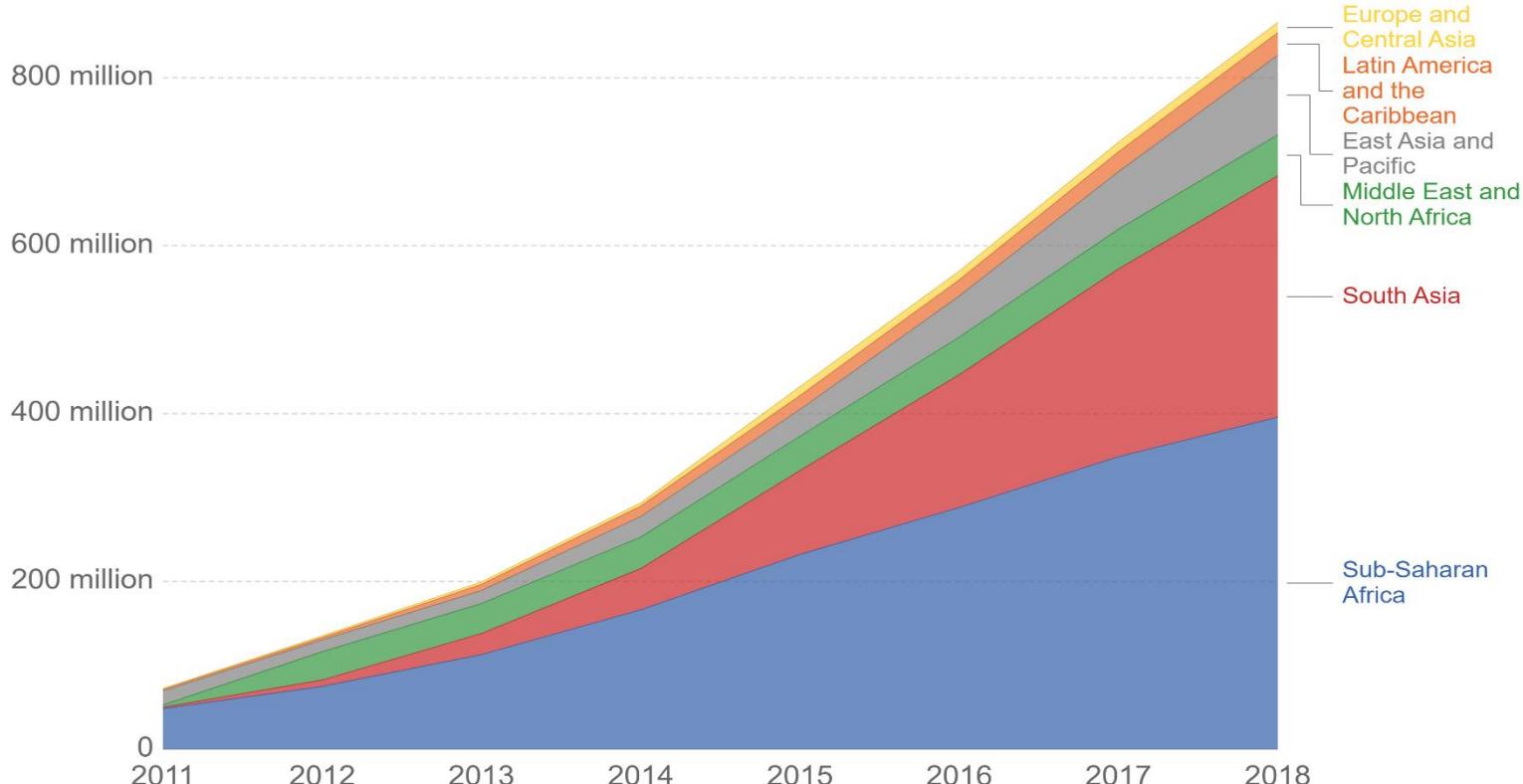
Financial markets

- New financial instruments
- Electronic stock exchange
- Timely information, assymetries eradication
- Intensification of trading
- Banking systems
- Robo-advising



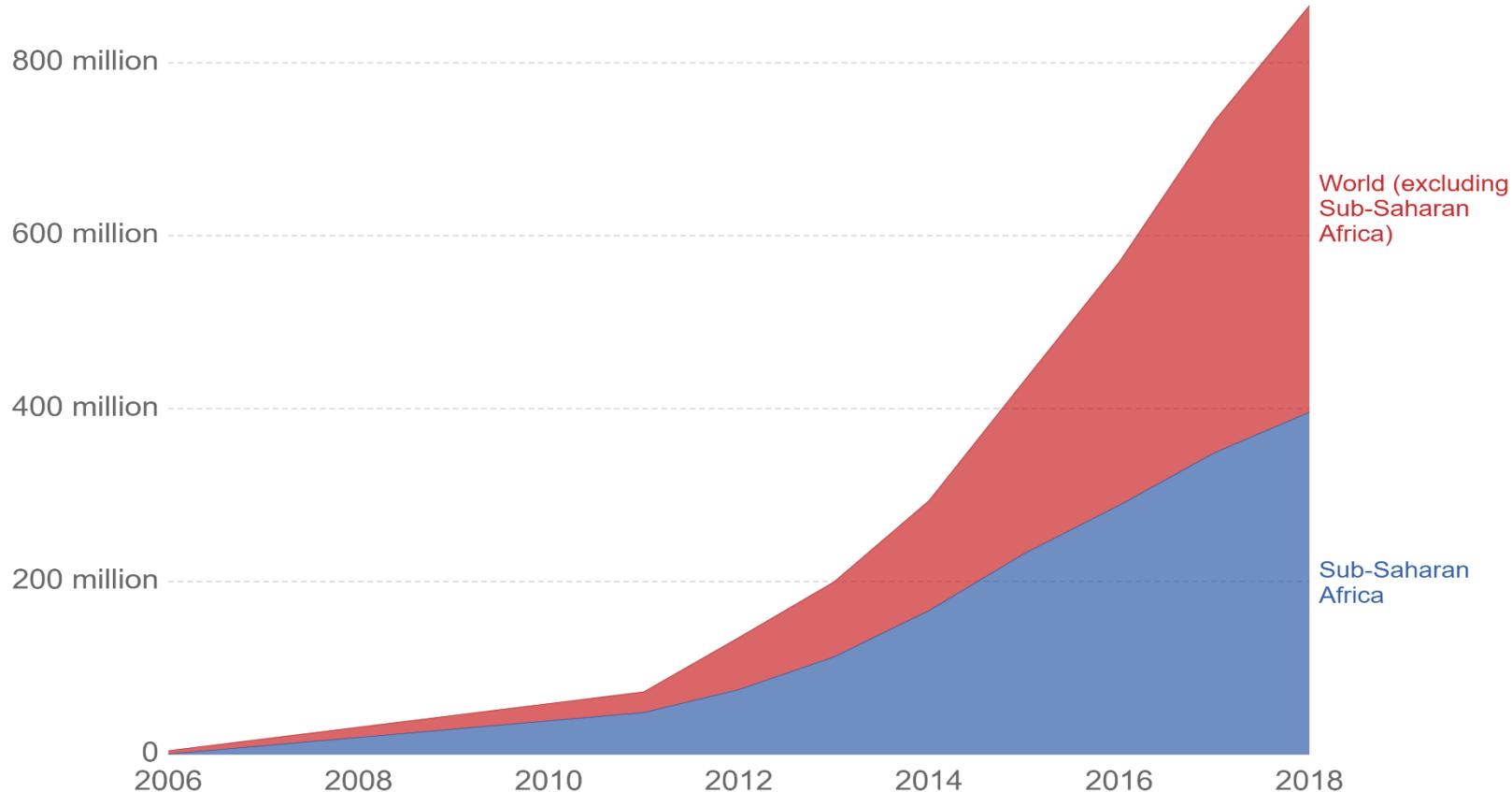
Registered Mobile Money Accounts by Region

The cumulative number of mobile money accounts at the end of the year by region. Mobile money services include transferring money and making payments using a mobile phone, without a formal account at a financial institution. North America is not shown since mobile money accounts are not utilised across this region.



Registered Mobile Money Accounts

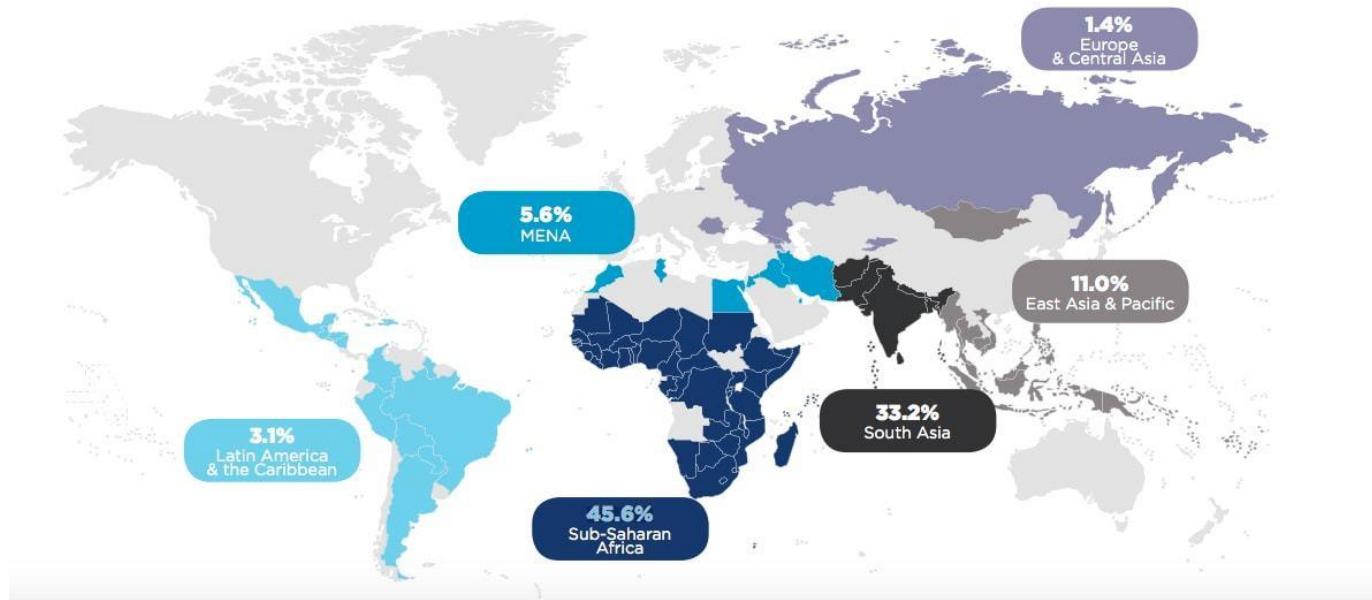
The cumulative number of mobile money accounts at the end of the year. Mobile money services include transferring money and making payments using a mobile phone, without a formal account at a financial institution.



"The power of financial technology to expand access to and use of accounts is demonstrated most persuasively in Sub-Saharan Africa," the World Bank's [Global Findex Database](#) wrote in its financial inclusion survey which found 21% of adults in the region now have a mobile money account.

Figure 1.

Global spread of registered mobile money customers, December 2018⁶



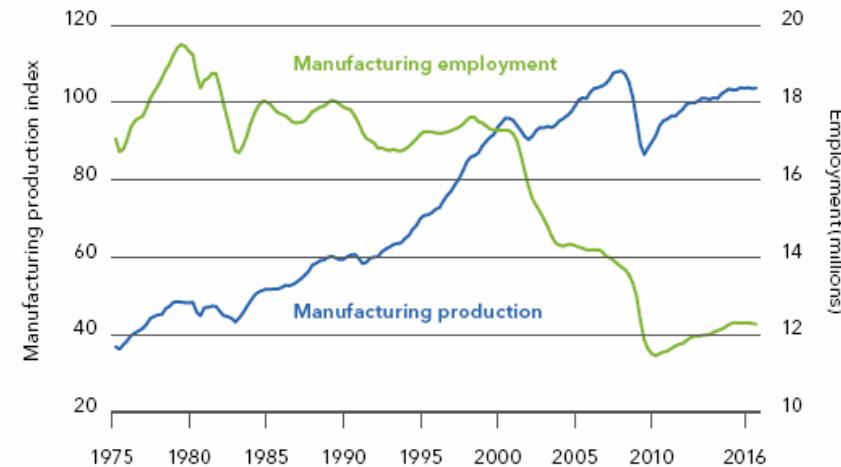
Robots (...) will eliminate some jobs, they will also create them. (...) as long as humans have been around and, when appropriately managed, brings more benefits than harm.



- Job Displacement Due to Automation is New
- Robots Cause a Net Job Loss
- Robots Will Lower Wages

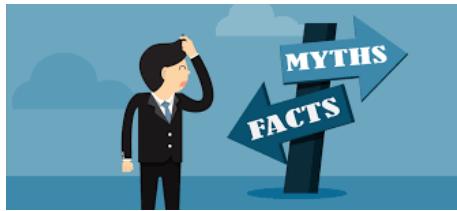
Rise of robots

U.S. manufacturing production and employment, 1975–2016



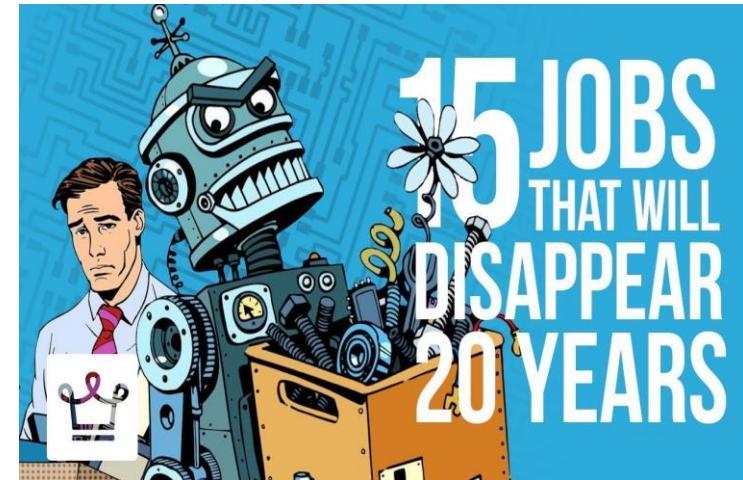
Sources: BlackRock Investment Institute, Federal Reserve and U.S. Bureau of Labor Statistics, November 2016.
Note: The base year (100) for manufacturing production is 2012.

Jobs disappearance – technological (un)employment?



The many faces of the robot revolution

	Humanoid Robots	Stationary Robots	Aerial and Underwater Robots	Non-humanoid Land Robots
Adoption among companies by 2022	23%	37%	19%	33%
First movers	(35%) Financial Services and Investors	(53%) Automotive, Aerospace, Supply Chain	(52%) Oil and Gas	(42%) Automotive, Aerospace, Supply Chain



Mechanization / robotization of production

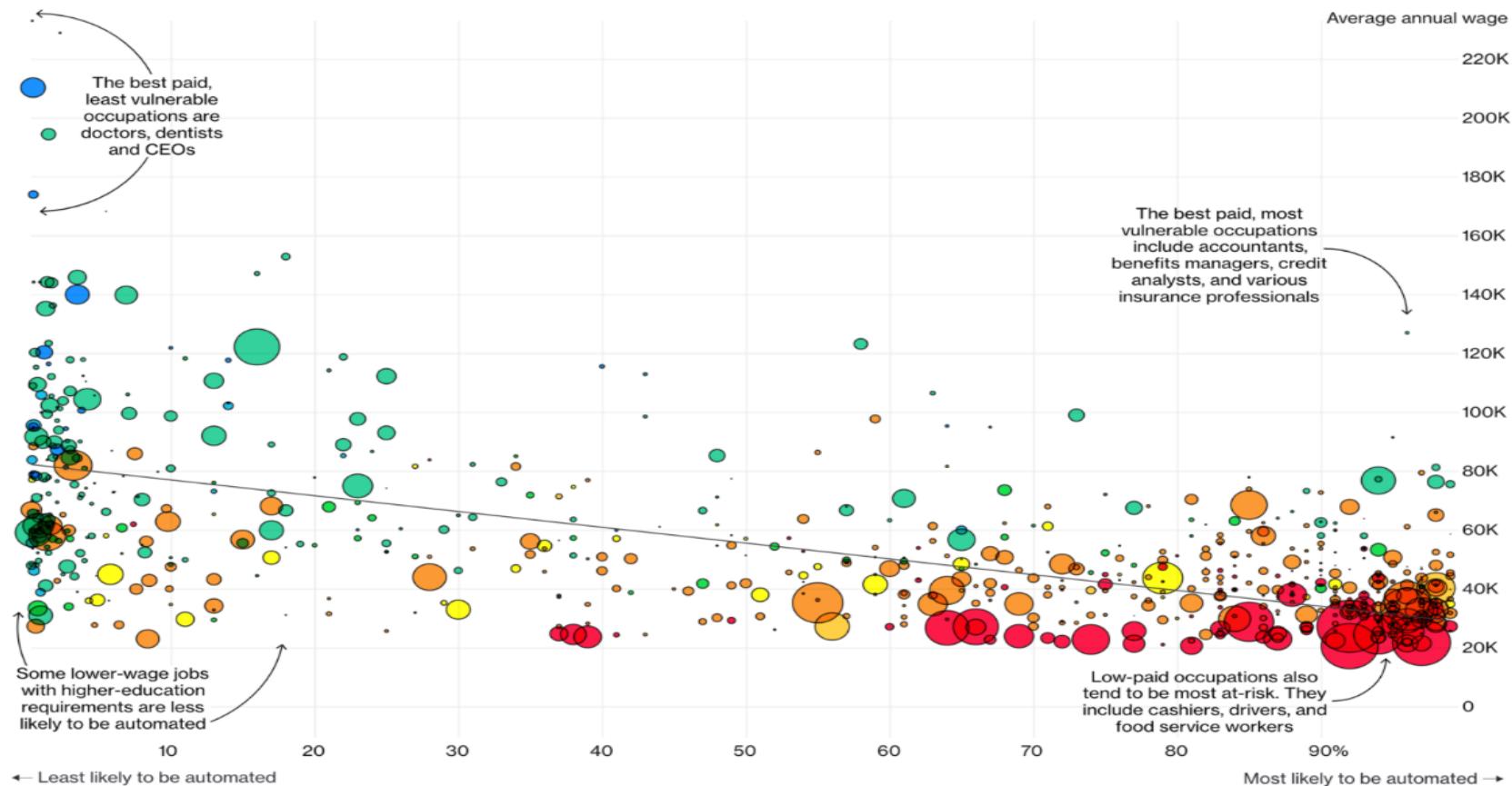
Brynjolfsson and McAfee (2011): the pace of technological innovation is increasing, with more ***technologies disrupting labour markets***

Frey and Osborn (2013) – approx. 45% of US jobs may disappear due to robotization



● Doctoral or Professional Degree
 ● Master's
 ● Bachelor's
 ● Associate's
 ● Postsecondary Nondegree Award
● Some College
 ● High School Diploma or Equivalent
 ● No Formal Education Credential

Search by occupation:

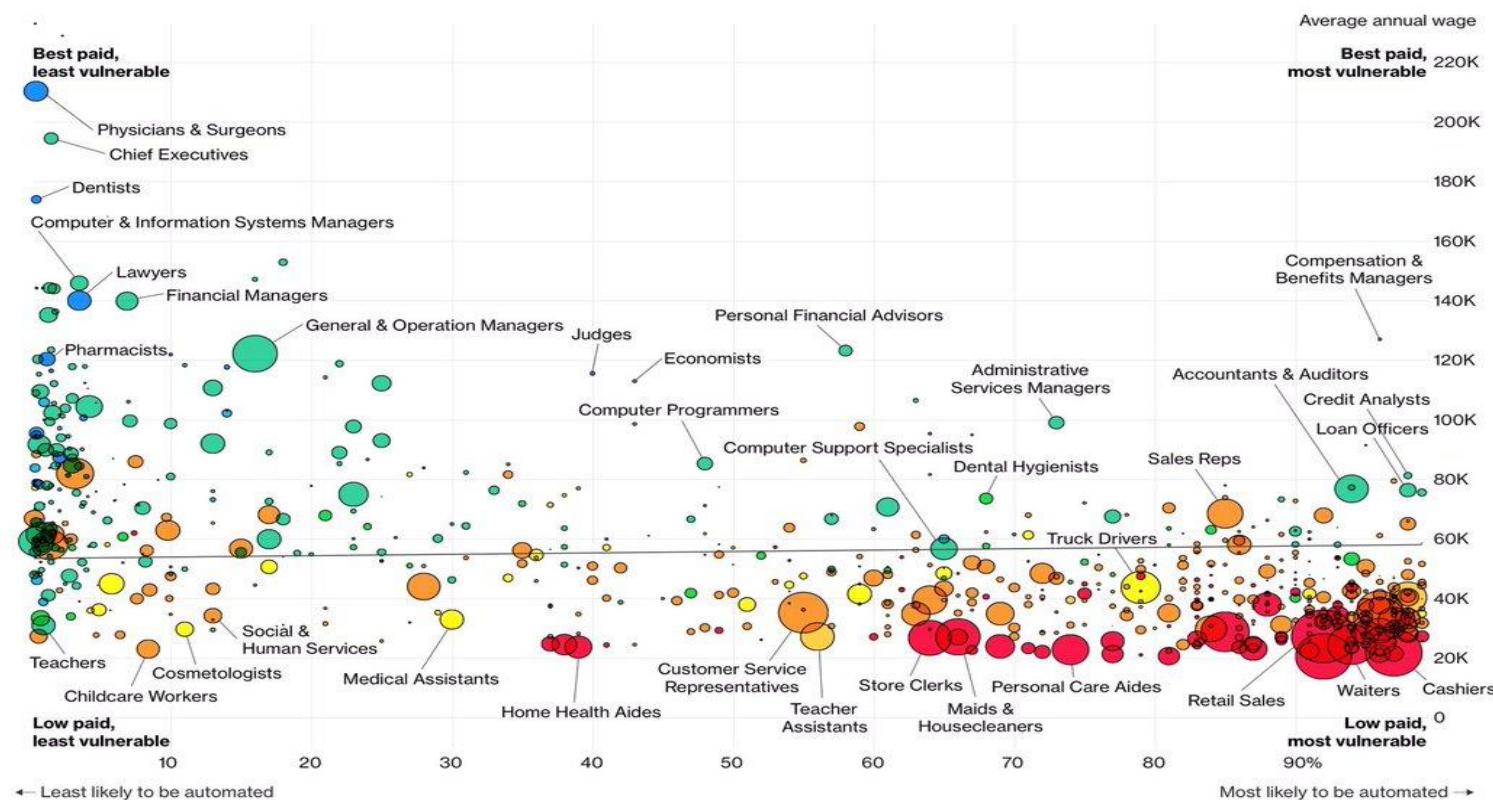


A College Degree Lowers Job Automation Risk

- Doctoral or Professional Degree
- Master's
- Bachelor's
- Associate's
- Postsecondary Nondegree Award
- Some College
- High School Diploma or Equivalent
- No Formal Education Credential

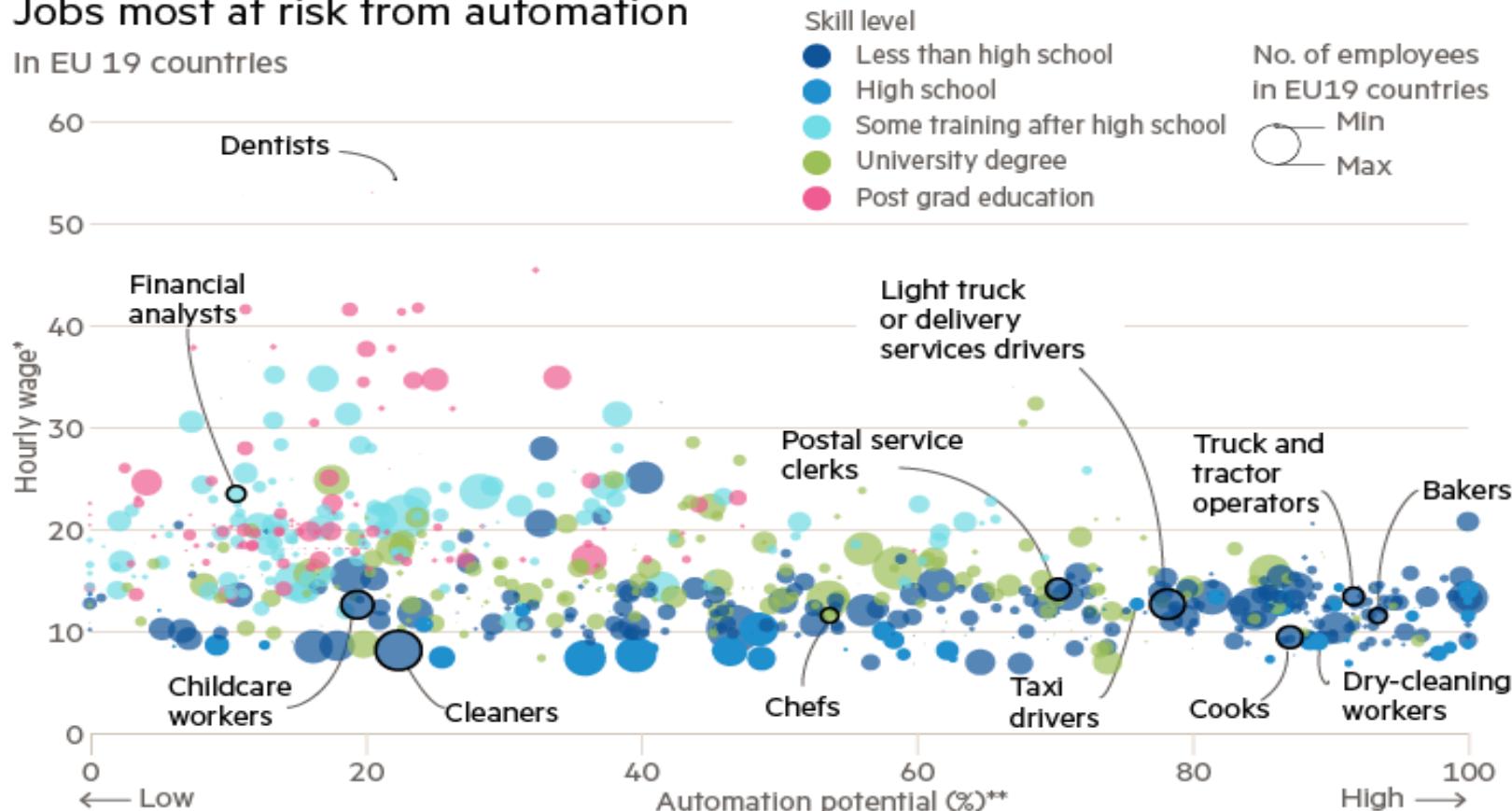
Search by occupation:

○ 100 K ○ 1M ○ 3M ○ 5M



Jobs most at risk from automation

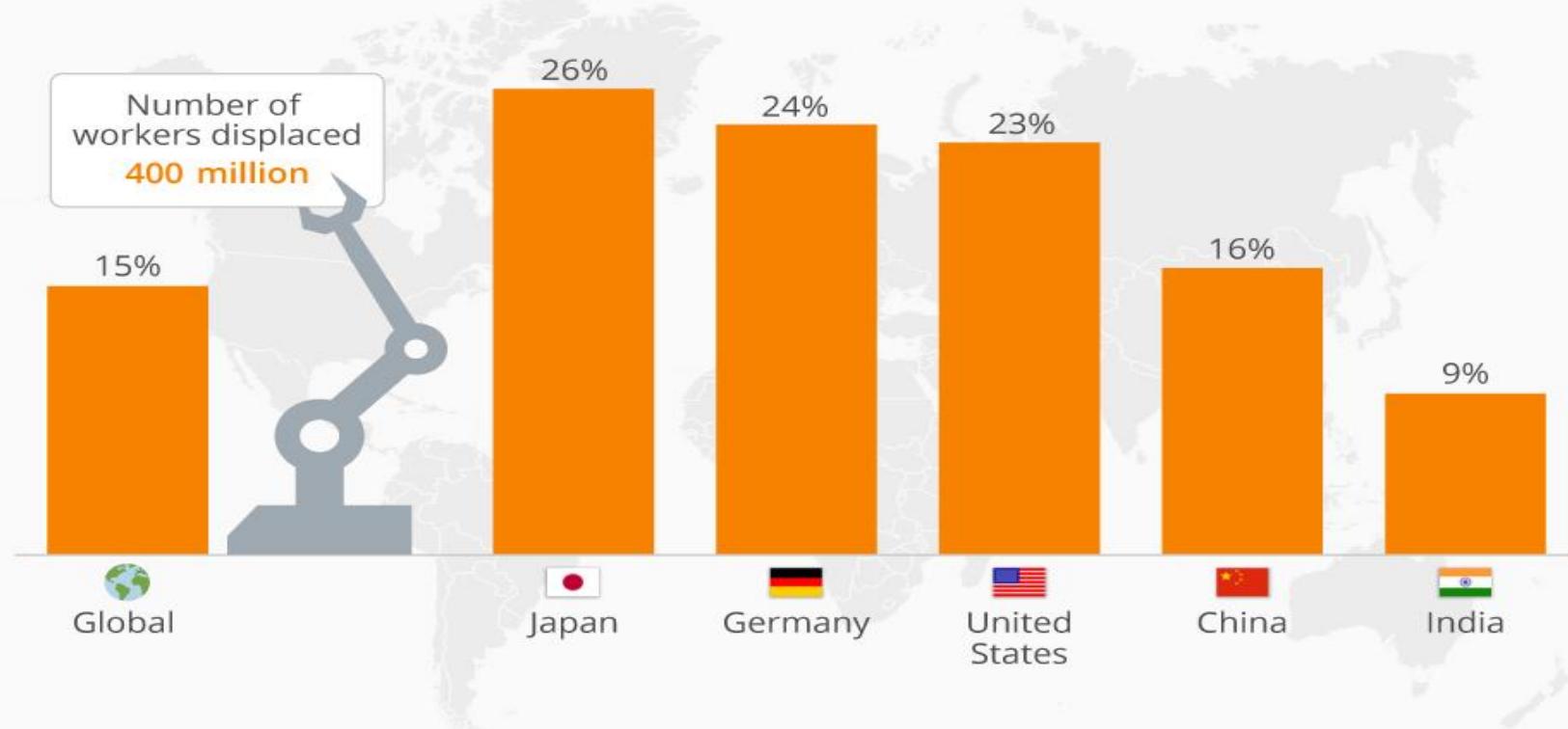
In EU 19 countries



*Average hourly wage (\$ at purchasing power parity), weighted average for EU19 workers **Estimated percentage of time in each job at risk of automation Source McKinsey
© FT

Autocomplete: Jobs Under Threat From Automation

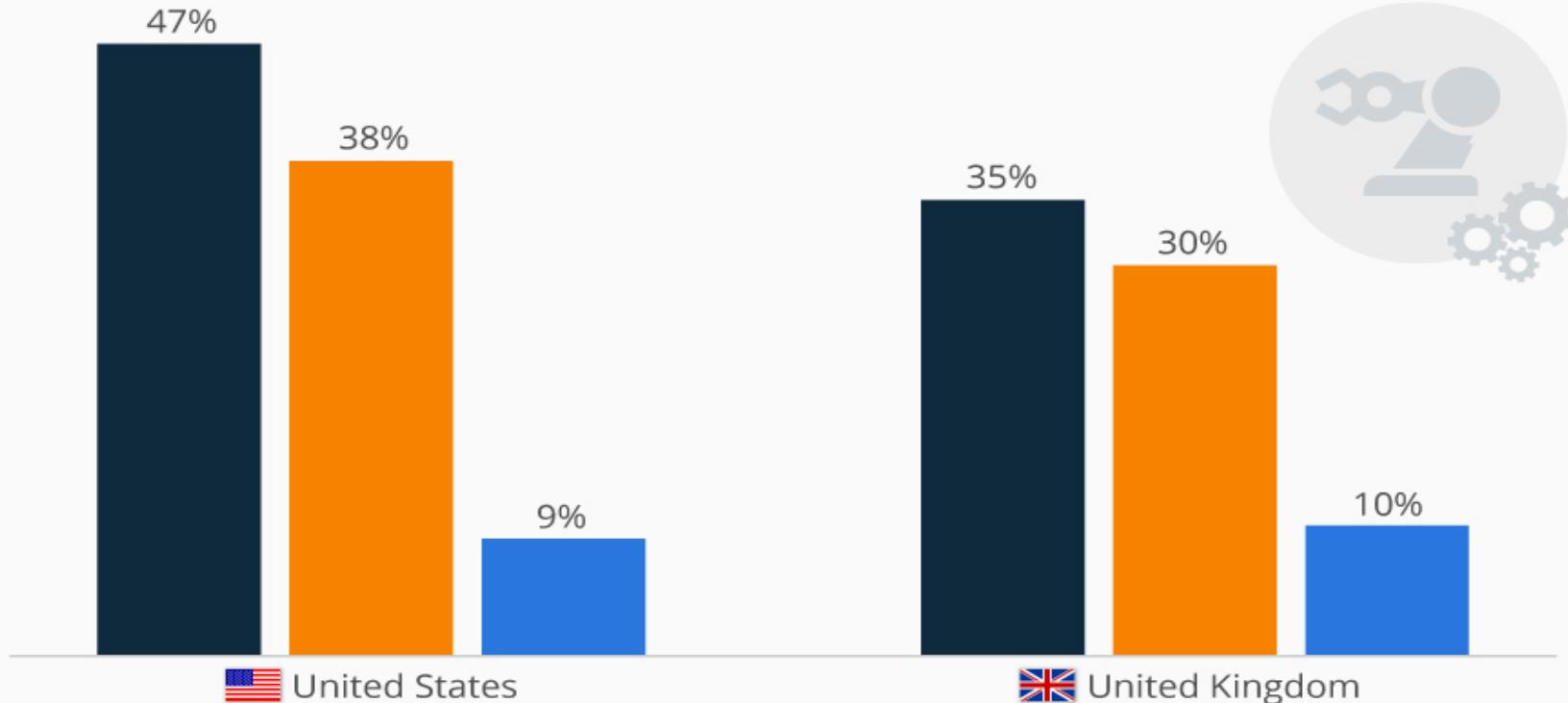
Share of current work hours with potential for automation by 2030 in selected countries*



Replaced by Robots & Algorithms

Predicted share of jobs at high risk of automation by 2030 in the US & UK (in %)

■ Frey and Osborne* ■ PwC ■ OECD



Around
85
MILLION JOBS

can be displaced by
2025 due to a **new**
generation of smart
machines

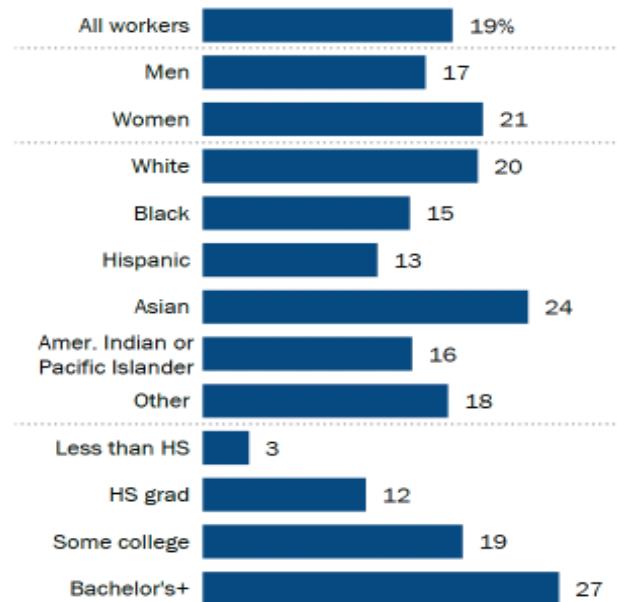
43%

of businesses
will cut down on their
workforce due to the
integration of new
technology



What shares of workers are most exposed to AI in their jobs?

% of U.S. workers employed in jobs that are the most exposed to AI in 2022



Note: Occupations are ranked by the relative importance of work activities with high exposure to AI. Those in the top 25% are the "most exposed," some 122 in number. Estimates by education level are for workers ages 25 and older. White, Black, Asian, and American Indian or Pacific Islander workers include those who report being only one race and are not Hispanic. "Other" includes all other single race groups and people reporting two or more races. Hispanics are of any race.

Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

Automotive industry USA: increase of robots and jobs

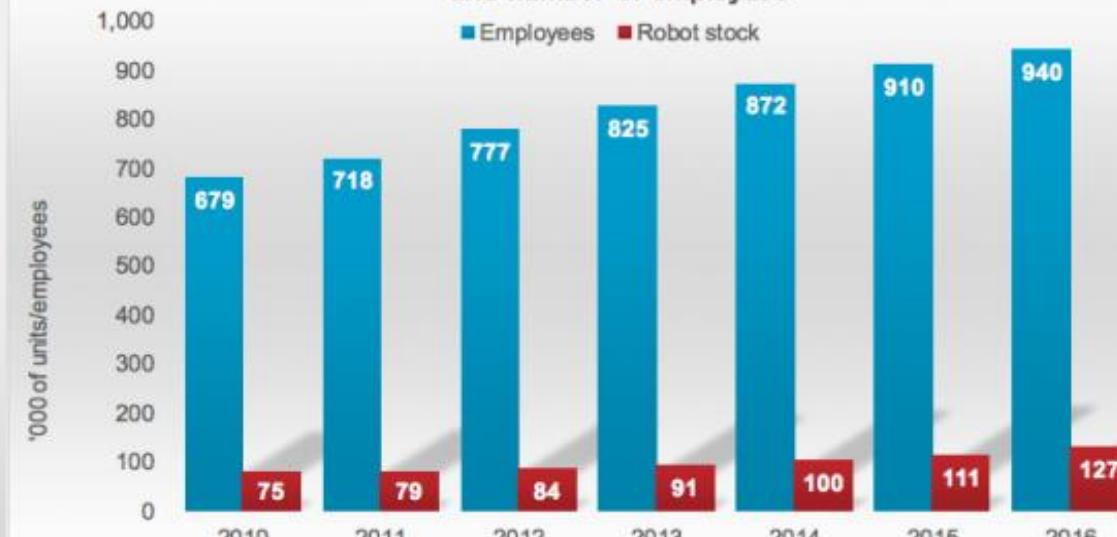
+9% CAGR

Stock of industrial robots
2010-2016

+6% CAGR

Employees
2010-2016

Automotive industry USA:
Estimated operational stock of industrial robots
and number of employees

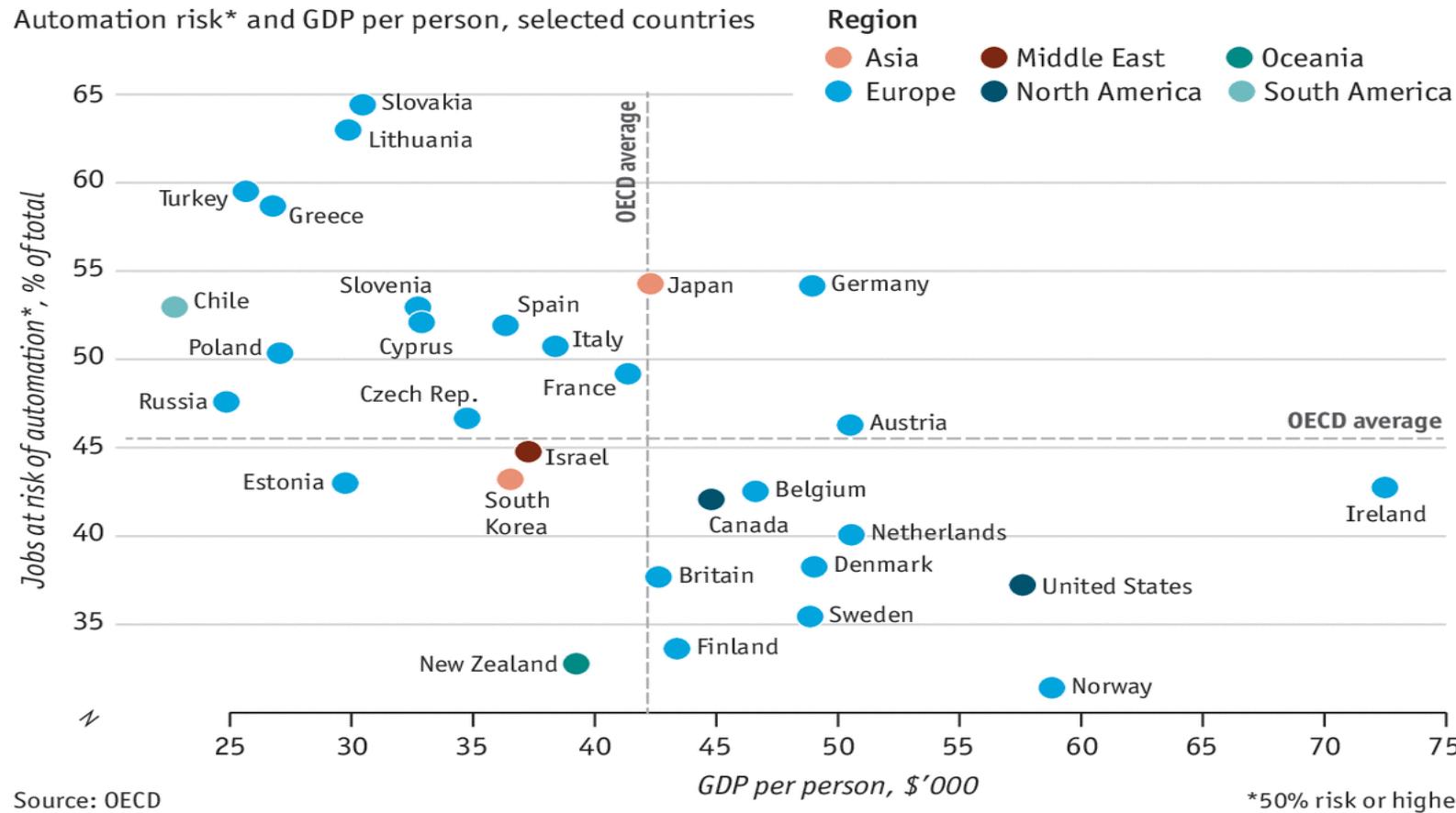


*preliminary results

Source: US Bureau of Labour Statistics and IFR Statistical Department

Wage against the machine

Automation risk* and GDP per person, selected countries



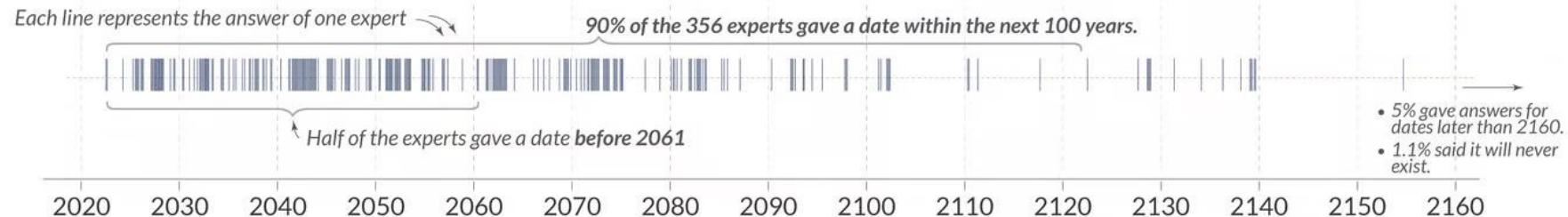
Source: OECD

When will there be a 50% chance that Human-level Artificial Intelligence exists?

Our World
in Data

Timelines of 356 AI experts, surveyed in 2022 by Katja Grace and colleagues.

The experts were asked when unaided machines will be able to accomplish every task better and more cheaply than human workers.



Data from Zach Stein-Perlman, Benjamin Weinstein-Raun, Katja Grace – 2022 Expert Survey on Progress in AI.

Licensed under CC-BY by the authors Charlie Giattino and Max Roser

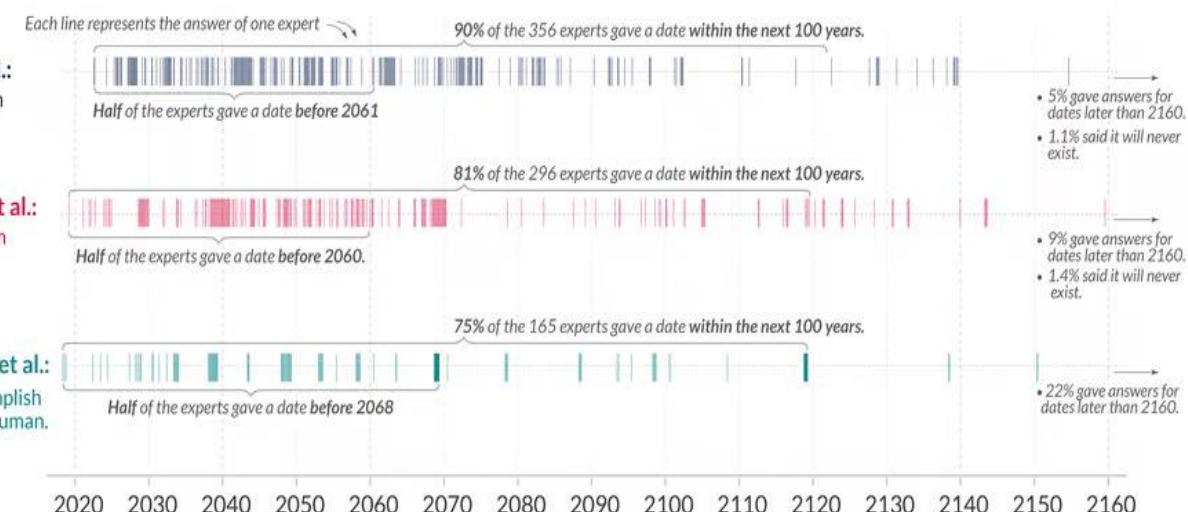
When will there be a 50% chance that Human-level Artificial Intelligence exists?

Timelines of 812 AI experts surveyed in three studies between 2018 and 2022.

Our World
in Data

1) Timelines of 356 AI experts, surveyed in 2022 by Katja Grace et al.:

The experts were asked when unaided machines will be able to accomplish every task better and more cheaply than human workers.



2) Timelines of 296 AI experts, surveyed in 2019 by Baobao Zhang et al.:

The experts were asked when machines will collectively be able to perform more than 90% of all tasks that are economically relevant better than the median human paid to do that task.

3) Timelines of 165 AI experts, surveyed in 2018 by Gruetzmacher et al.:

The experts were asked when AI systems will collectively be able to accomplish 99% of tasks that humans are paid to do at or above the level of a typical human.

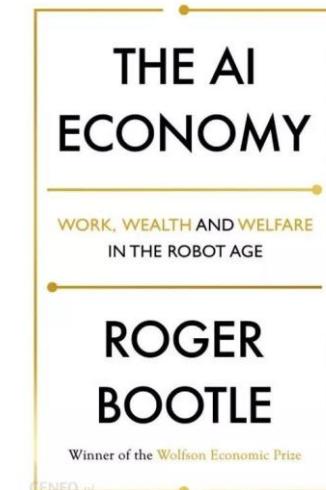
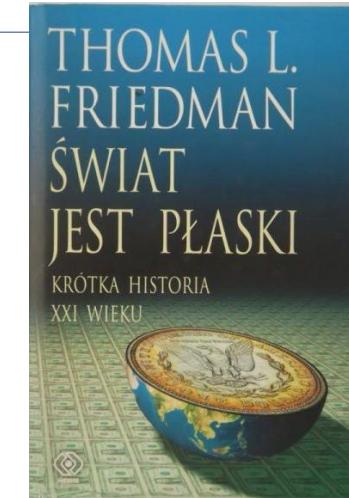
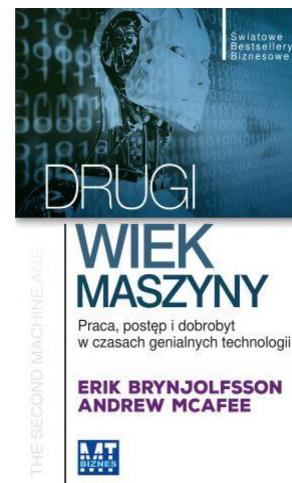
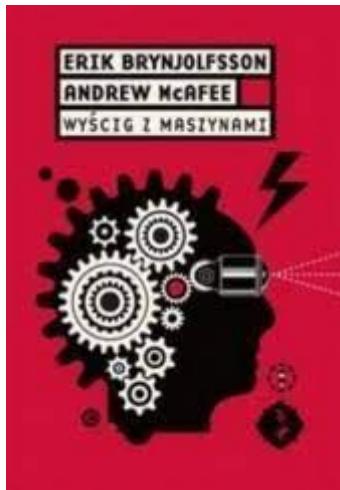
Full details on all studies and the questions that the AI experts were asked can be found in the text at OurWorldInData.org/AI-timelines.

OurWorldInData.org – Research and data to make progress against the world's largest problems.

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Polecam

- Gapminder



Dziękuję za uwagę😊

Wszystkie zdjęcia zostały wykorzystane bez wiedzy i zgody autorów

Prezentacja zawierała lokowanie produktów



- https://www.ted.com/talks/hans_rosling_the_magic_washing_machine/transcript
- https://www.ted.com/talks/nick_bostrom_what_happens_when_our_computers_get_smarter_than_we_are
- https://www.ted.com/talks/anthony_goldbloom_the_jobs_we_ll_lose_to_machines_and_the_ones_we_won_t
- https://www.ted.com/talks/daniel_susskind_3_myths_about_the_future_of_work_and_why_they_re_not_true/transcript