How Smart Machines Transform the Economy

Economic Opportunities and Risks of New Technologies

Paper given at the conference on “Integration and Disintegration in the Japanese Vision of Society 5.0: A Model for an Open Society in Europe?”, Institute for Security and Development Policy, Stockholm, Sweden, 13-14 April, 2018

Heinz D. Kurz
University of Graz
Graz Schumpeter Centre
heinz.kurz@uni-graz.at

Contents

Haas, D., Kurz, H.D., Palan, N., Rainer, A, Schütz, M. and Strohmaier, R. (2016). Technical Change and Innovation, in G. Faccarello and H.D. Kurz (Hrsg.), *Developments in Major Fields of Economics*, Cheltenham und Northampton: Edward Elgar.

Kalmbach, P. and Kurz, H.D. (1991). *Chips und Jobs. Zu den Beschäftigungswirkungen programmgesteuerter Arbeitsmittel*. Marburg: Metropolis.

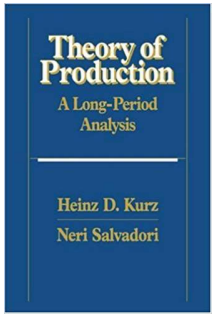
Kurz, H.D. (2008). Innovations and Profits. Schumpeter and the classical heritage. *Journal of Economic Behavior and Organization*, Bd. 67: 263-278.

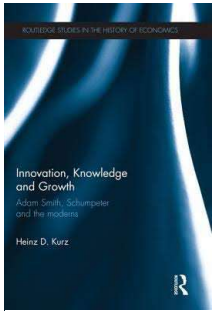
Kurz, H.D. (2011). *Innovations, Knowledge and Growth. Adam Smith, Schumpeter and the Moderns*. London: Routledge.

Kurz, H.D. (2017). Auf der Schwelle zur „Vierten Industriellen Revolution“, *Wirtschaftsdienst*, 11: 785-792.

Kurz, H.D. und Salvadori, N. (1995). *Theory of Production. A Long-Period Analysis*. Cambridge: Cambridge University Press.

Research project funded by the Austrian Research Foundation: “Wie ‘smarte Maschine’ Österreichs Wirtschaft verändern”





I. Introduction

- Implications for economy and society – involves a tricky imputation problem: What is responsible for what?
- What is the time horizon? The further we go into the future, the more uncertain our views become.
- What can today be known about the possibilities and limits of Artificial Intelligence (AI)?
- Beware of a “pretence of knowledge”! (John Maynard Keynes and Friedrich August von Hayek)
- Does your Majesty already know what’s old?

Whoever pretends to be able to forecast the future is a liar, even if the actual course of events happens to support his forecast.

(Arabic saying)

This does not mean that we cannot say anything.

And many things are being said! Some believe to discern the Horsemen of the Apocalypse at the horizon, others the Entrance to the Paradise on Earth.

"... endangers millions of jobs and is responsible for populist movements" (*Das Digital*)

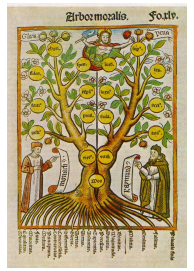
- A world of “abundance and luxury” is ahead of us (Brynjolffson) – the paradise on earth (Marx 2.0)
- A concentration of economic and political power in a few hands never experienced before
- Tends to undermine decentralised decision making
- …
- How to separate the chaff from wheat in this?

Difficulties of the analysis

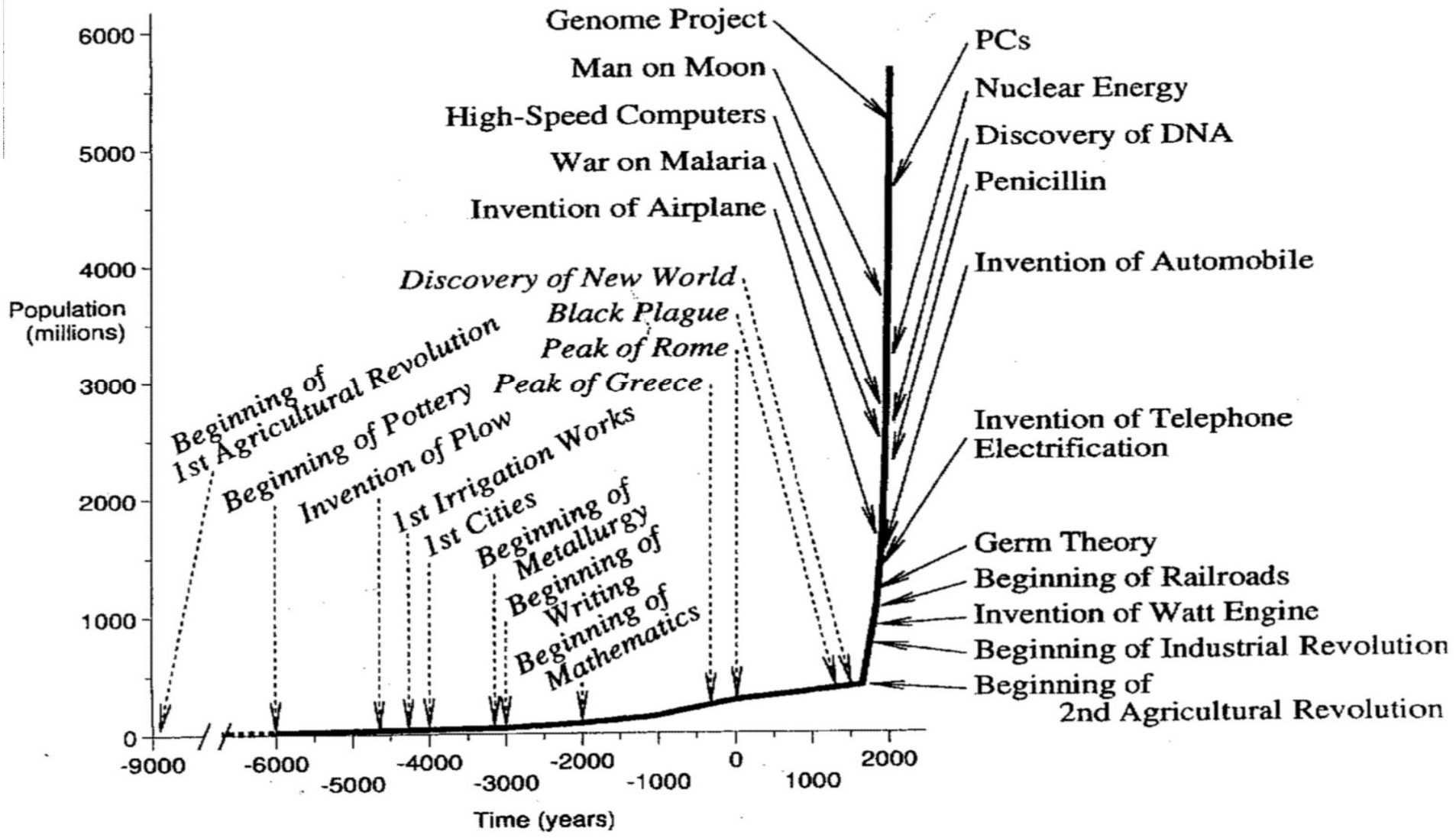
- Unintended consequences of human behaviour. Adam Ferguson (1767): “History is the result of human actions, but not of human design.” Limitation of our cognitive capabilities.
- Adam Smiths (1776) “Invisible Hand”
- Circular and cumulative causation (increasing returns to scale and cope, network effects and productivit/efficiency enhancing feedback loops in data rich markets)

II. Short Account of the History of Technology

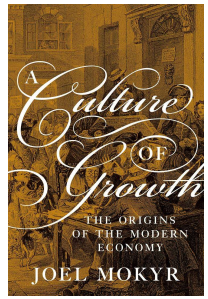
- Joseph A. Schumpeter (1912): "Innovations are the overwhelming fact in the economic history of capitalist society."
- Schumpeter uses the combinatorial mataphor Metapher – like Smith before him: innovations are "new combinations"
- These make the tree of knowledge grow
- The "quantity of science" decides the wealth of a nation (Smith 1776)
- Different forms of technical progress: Ricardo, Babbage, Marx

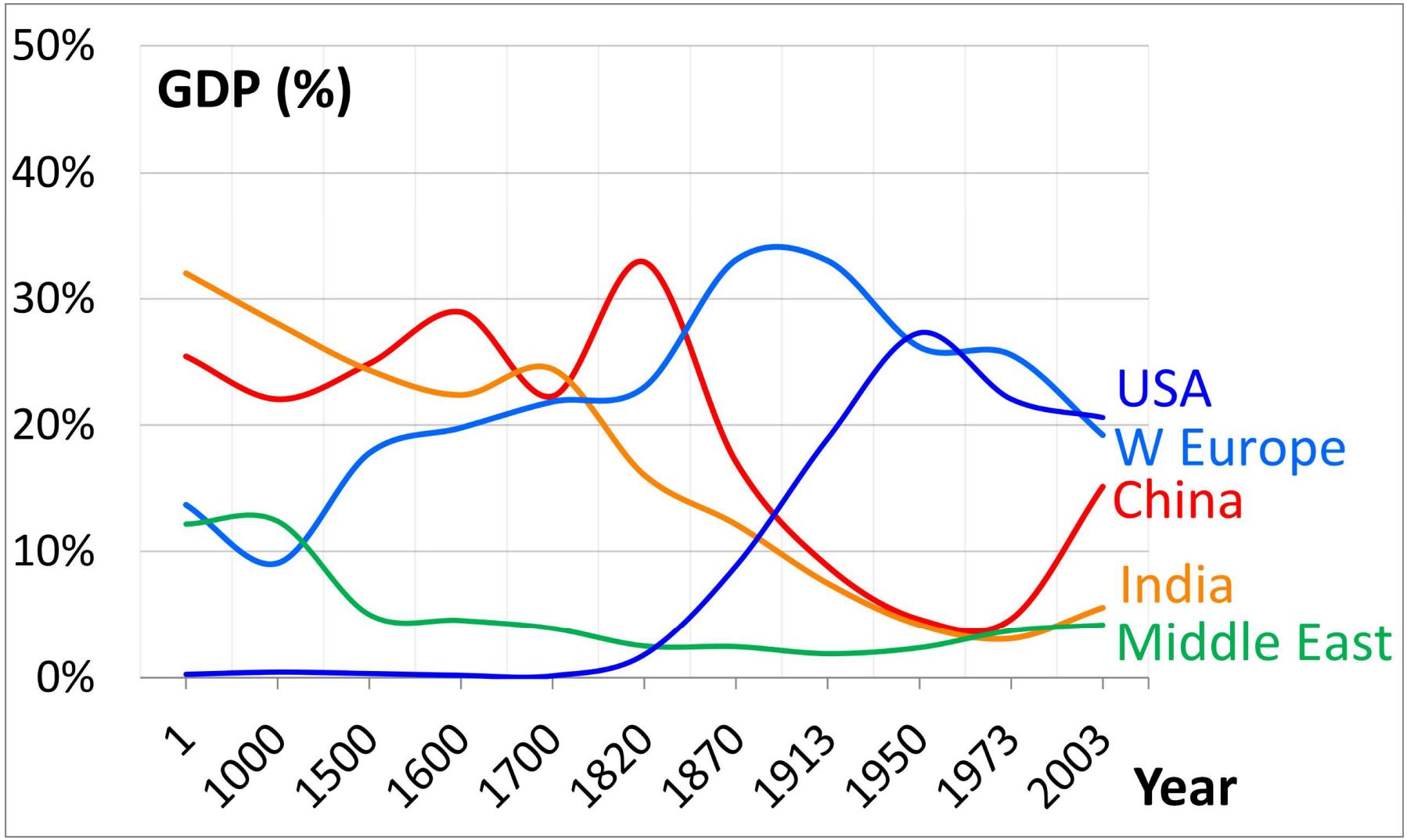


The History of Mankind at a Glance



- As a consequence of the First Industrial Revolution the “Great Divergence” (K: Pomeranz)
- Why IR 1.0 in Europe, not in China?
- Answer by David Hume (1742)
- Joel Mokyr: a “Culture of growth”




GDP (%)
50%
40%
30%
20%
10%
0%
1
1000
1500
1600
1700
1820
1870
1913
1950
1973
2003
Year
USA
W Europe
China
India
Middle East

Full automatisation

- David Ricardo (1821): "If machinery could do all the work that labour now does, there would be no demand for labour. Nobody would be entitled to consume any thing who was not a capitalist, and who could not buy or hire a machine."
- Problems: Employment, income and wealth distribution

What is new in the so-called "Fourth Industrial Re-volution" (Schwab)/"Second Machine Age"? (Bryn-jolffson and McAfee)?

Learning machines

Machines

- are “mute agents” of production (Ricardo)
- need no sleep
- do not ask for higher wages, holidays and better conditions
- learn day and night
- work on Mondays as well as during the rest of the week
- are in “constant competition” with workers (Ricardo)
- but now competition at a higher level: dynamic as opposed to static
- Will there be a technological singularity point?

Is technical porgress always a universal blessing?

1. No, not at all. In the short and medium run, there are always winners and losers. It is a process of "creative destruction" (Schumpeter)

- Danger of "technological unemployment"?
- "Why are there still so many jobs?" (David Autor, 2015)
- Short vs. long run.

2. Innovations can worsen the situation in the economy as a whole

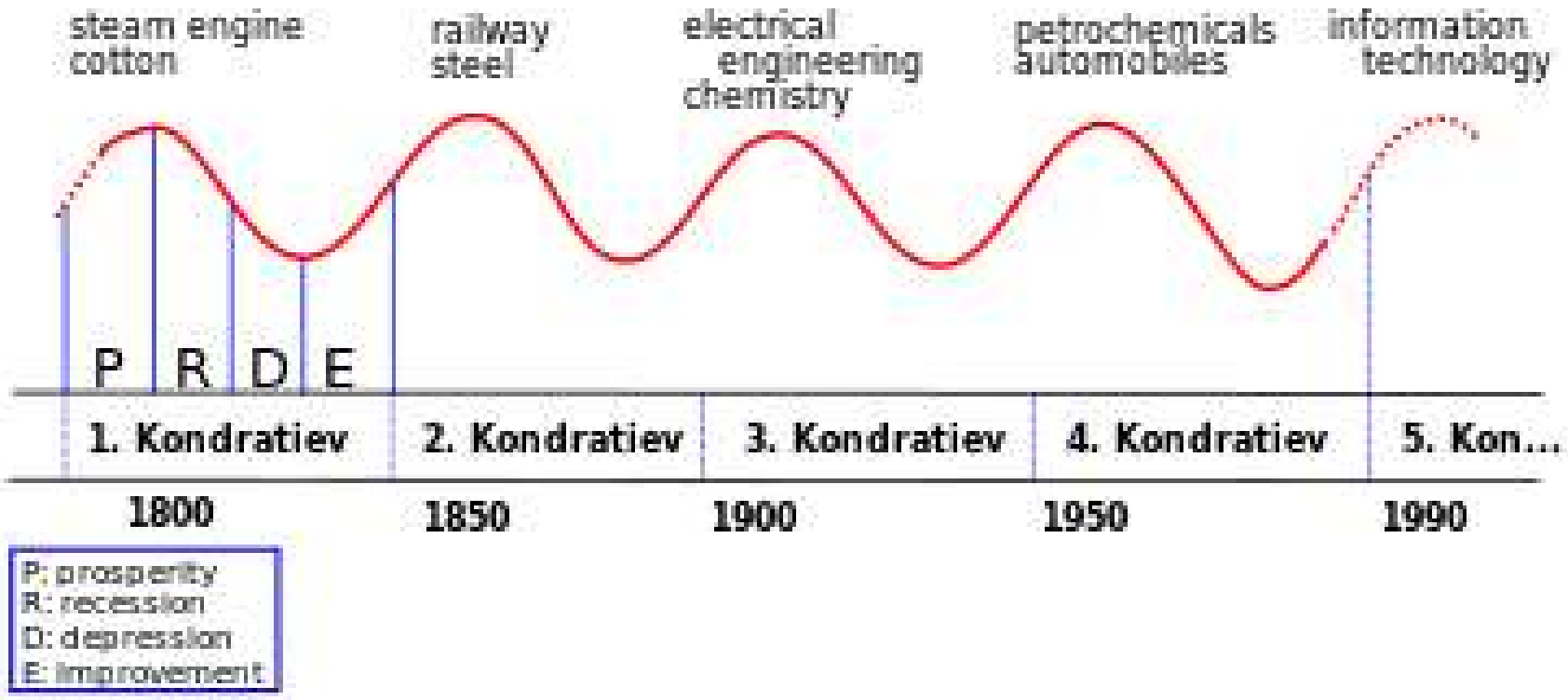
- World Economic Crisis I – around the turn of the 20th century huge agricultural innovations in the USA
- "Great Recession" – innovations in the financial sector (structured financial products, credit default swaps)

3. Technical progress helps to solve problems, but creates new ones.

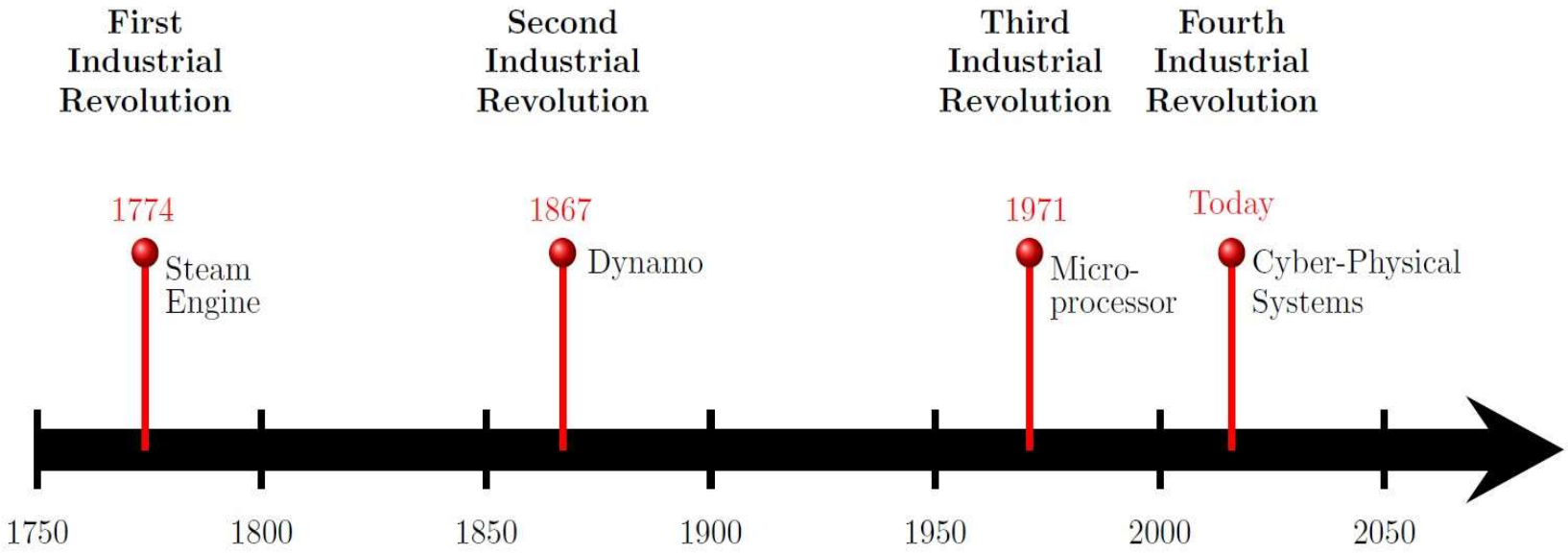
III. Technical Progress, Industrial Revolutions and Long Waves

- Each IR and each long wave is based on one or several General Purpose Technologies (Bresnahan and Trajtenberg, 1995)
- These are characterized by
  1. Pervasiveness: wide range of applications and widely used across sectors of the economy
  2. Scope for improvements: not a ready-to-use technical solution, but one that improves over time
  3. They trigger complementary (organizational) innovations and change the infrastructure
  4. They deeply affect the economic structure and workforce

Kondratieffs



From Industry 1.0 to Industry 4.0



Fourth Industrial Revolution

- Is based on Industry 3.0 (Microprocessor, Computer, Internet) and technologies like cyber-physical systems (combination of information and software components with mechanical ones)
- Self-regulation of the system of production
- The system learns from the past, processes autonomously information and adjusts to changing conditions
- Increases flexibility in production and allows for individualised mass production (mass customization)
- Data assume centre stage: their processing drives further technical improvements

Smartness all over the place

- Energy distribution
- Transport
- Medical services
- Banking and finance
- Environment
- Households, cities
- Military
- Criminality

IV. Effects on the Economy and Society

1. General

- Conventional markets: all information bundled in a single variable – the price (Hayek)
- Markets rich with data: comprehensive, multidimensional information – allows better coordination, reduces risks and prevents bubbles. (Aggregation of information?) Via the Internet – huge expansion of markets
- Systems and algorithms (decision assistents) learn and overcome cognitive distortions ("complexity aversion", "loss aversion", "negativity dominance", „affirmation and attribution errors" (Kahneman, Tversky)
- Data transfer cheapened by digitalisation

- Intelligent decision assistants that never sleep and are possessed of an infinite learning capacity learn our preferences via personalised information systems
- Unbundling of the value chain because of strongly falling transport costs (R. Baldwin)
- “Digital Taylorism” – Scientific Management worldwide
- Internationalisation of production
- Date assume two important roles: (i) that of new “money” or general equivalent and (ii) that of a productive resource: they fuel the learning of machines
- Data gain in importance relative to labour, capital and traditional money: DATA CAPITALISM

Deep reaching transformation of our societies

Firms: two competing coordination mechanisms

- Market: realm of freedom and (formal) equality; information flows horizontally
- Command: firms are hierarchical; information flows vertically; firms exist inter alia because of transaction costs
- Virtual firms operate in the “cloud”; footlose; profit shifting
- Platform economy: creates own markets, own rules
- Unfair competition with conventional firms
- Decreasing control over employees and rising costs of organisation. Trad. firms tend to lose in the long run.

Workers and trade unions

- Platform work challenges traditional jobs
- “Cloud workers”, quasi self employed, free lance, but not covered by social security
- Low rates of union membership
- New forms of the putting out system (“gigs”)
- Unfair competition with traditionally employed workers
- Process of unbundling and worldwide dispersion.
- Loss of collective representation of labour interests

State

- Eroding tax base in parallel with rising state tasks
- Huge task of regulating data capitalism
- Formation of a digital competence
- Danger of system breakdown
- Cyber criminality

2. Market form

Tendency towards concentration of market power and monopolies

1. Increasing returns to scale that are internal to the firm (“law of mass production”)
2. Economies of scope
3. Network externalities
4. Feedback loops in learning systems (AI) – unit costs negatively correlated with amount of data

Adam Smith: “wretched spirit of monopoly” – phase 2

Network externalities

- Exploitation of scale economies: the attractiveness of a network rises with the number of clients it has. Who is large will become larger!
- Examples: telephone net, online marjet platforms, social media platforms, computer software

Feedback loops

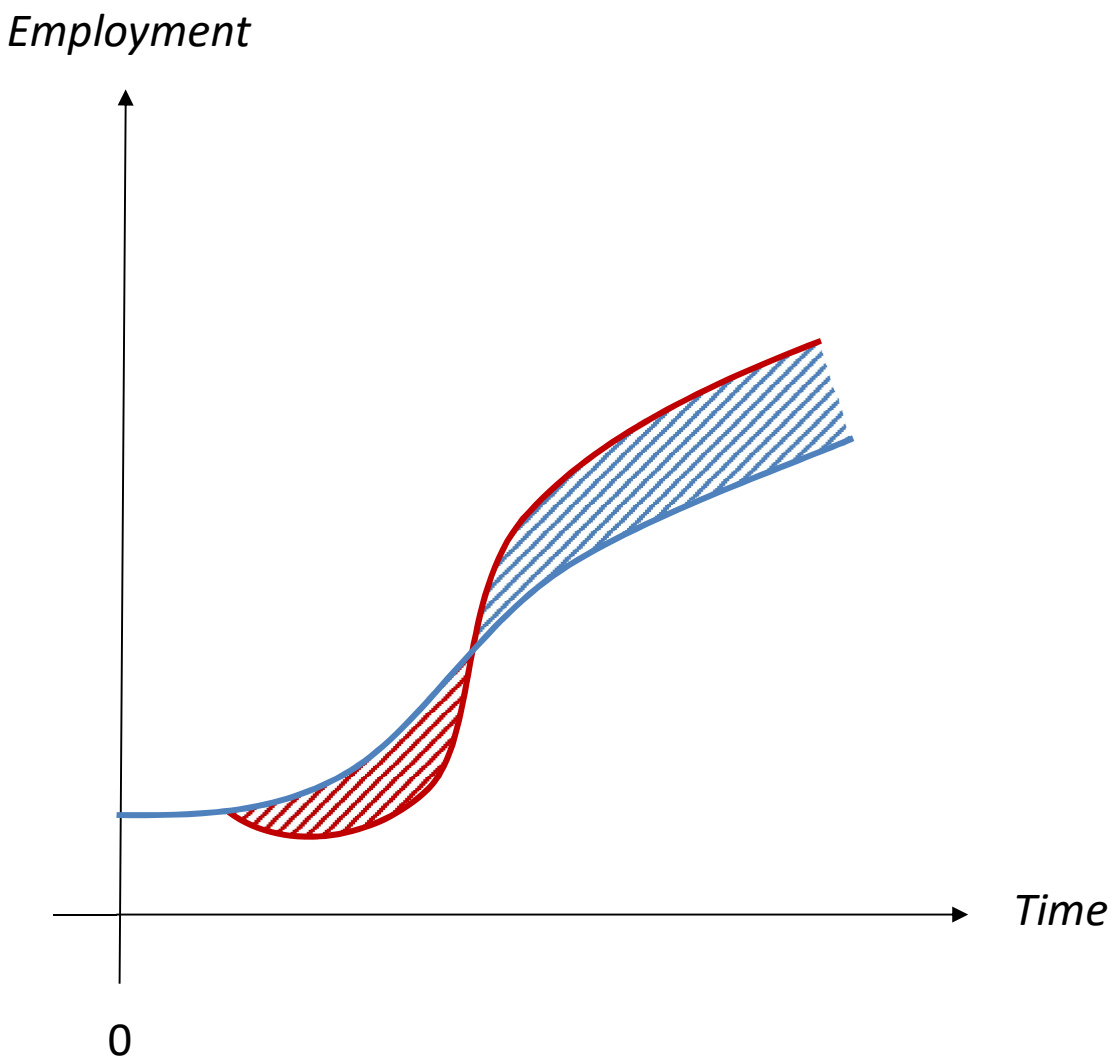
- AI and feedback loops: collection and processing of data optimizes the systems bahaviour and increases its range of applications. The larger the cumulated amount of processed data the better is the performance. Who has a competitive edge will keep it
- Examples: diagnosis systems in medicine; corrections of auto pilots

- Emergence of “superstar firms” (David Autor) with a small staff and a high degree of automation – large inequality amongst firms
- Market entry of new firms gets almost impossible; end of a functioning competition; implications for income and wealth distribution
- Visible hand of the big firms
- Monopolization: only one decision assistant system – systemic risk increases
- Danger of manipulation; control of our behaviour; “digital slaves”
- Dangerous concentration of decision power and control

3. Labour market

- “Technological unemployment” and economic history
- From the Luddite movement to the World Depression
- “Why are there still so many jobs?” (David Autor, 2015)
- Past experience cannot establish a generally valid law; new forms of technical progress, new effects
- How many jobs will be churned?
- In the long run: no job will in all probability survive in its present form

- The only constant is permanent change
- Only those new techniques matter which will actually be adopted: Many inventions find their way into patent offices but not the way out of them
- Cost minimizing behaviour will also affect well paid jobs (wage dispersion and incentive)
- What matters is the time profile of labour displacement and labour compensation: short run vs. long run


Employment
Time
0

- Process innovations
- Product innovations

Robert Gordon vs. Joel Mokyr

- At present: the calm before the storm?
- Small productivity increases recently
- Directed technical progress (lock-in phenomena; e.g. nuclear energy)
- C. Mazzucato: The Entrepreneurial State
- Co-evolution of private and public sector

- Strongly falling transport costs lead to an unbundling of the value chain (R. Baldwin):
- “Digital Taylorism”
- How to deal with excess information / Pattern-matching-algorithms (learning systems that train themselves)
- Intelligent decision assistents with infinite learning capacity identify our preferences and act accordingly
- Market efficiency increases via an improved information flow and its transformation in decisions and actions

Types of automation

- Machines *guide* workers
- Machines *assist* workers

Polarisation of employment

Little qualified workers under pressure because of

- globalisation (competition from workers in China and India) and
- labour saving technical progress at home

Danger of new precarious jobs

- „Cloudworking“: fall in average education level (Guy Standing 2015)
- Impact on labour organization and social security systems
- Emergence of “digital daily workers“ (Boes et al. 2015) – self-employed at low wages – competitive pressure on the ordinarilyemployed workers
- „Gig Economy“ and “ Crowdsourcing”

New jobs (“labour compensation”) via the following channels:

- Increasing profits – increasing investment demand
- Falling unit costs (in competitive conditions) – falling goods’ prices – increasing consumer demand
- Falling goods’prices – increasing export demand (increasing national income – increasing import demand)
- New consumption goods and means of production – establishment of new markets – investitionments etc.

- The task composition of labour will change markedly. The education sector will have to provided the required qualifications of workers. The competitiveness of firms and possibly the entire economy (GPT) depends on the concordance between available and required qualifications.
- The problem is not a general “higher” qualification, but a better fit.
- MINT (mathematics, informational science, natural sciences, technology)
- Increased need of digital competences.

- Big Brother endangers the open society
- Instead of Utopia – Dystopia: enslavement of people, eliminations of all liberties by an all-important technique , developed by man, but no longer controlled by him / Totalitarian state with a small number of privileged people and the rest having a low standatd of living –
- New Malthusianism (Korinek, Stiglitz)

V. “Creative destruction” – how to cope with it?

- Winners and losers. How to distribute benefits and costs? Must the winners compensate the losers?
- John Rawls (*Theory of Justice*)*:* ficticious decision situation behind a veil of ignorance: you decide about a future situation, but do not know, which position you will have in it. Impartial decision leaving behind your present social position and interests.

- An optimal risk allocation would imply that winners are prepared to compensate losers.
- In an ideal case nobody would worsen his or her position, all would improve it.
- In such a case there would be no need to redistribute gains and losses post factum, because all people would participate in the benefits of technical progress and any losses incurred would be made good.

- However, in the real world such ideal conditions do not prevail. There is fundamental uncertainty about the future. No full information / cognitive distortions / opinion dynamics / economic and social power etc.
- Hence a redistribution cannot be avoided post factum: the market results cannot be accepted as they are, but need some regulations and post factum corrections

- This view gets additional support from the fact that technical progress and the benefits and costs it engenders are not only the result of private enterprise, but also of the provision of public goods.
- What is more, several important technological breakthroughs were essentially publicly financed and targeted public (military etc.) goals. Hence the society at large was involved and should receive a part of the benefits.
- Mazzucato: *The Entrepreneurial State*
- We are facing a difficult imputation problem, but it is obvious that some sharing of the benefits is appropriate.