Education
in the third machine age

Gianmario Verona
Fondazione Romeo ed Enrica Invernizzi Professor of Innovation Management
at *Bocconi University* and Chairman of *Fondazione Human Technopole*

Centesimus Annus, International Convention Vatican City

21/06/2024

Agenda of my talk

1. Context: The third machine age
2. Behavioral and economic implications
3. Education and technical change
4. Conclusions

Agenda of my talk

1. **Context: The third machine age**
2. Behavioral and economic implications
3. Education and technical change
4. Conclusions

FIRST MACHINE AGE

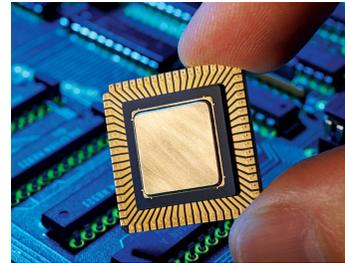- Machines with cognitive power
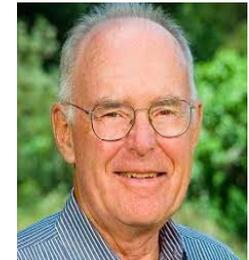

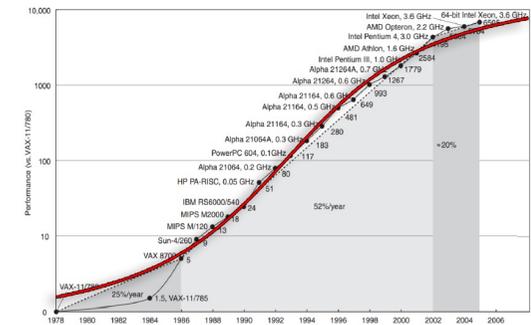1960's   1970's   1980's

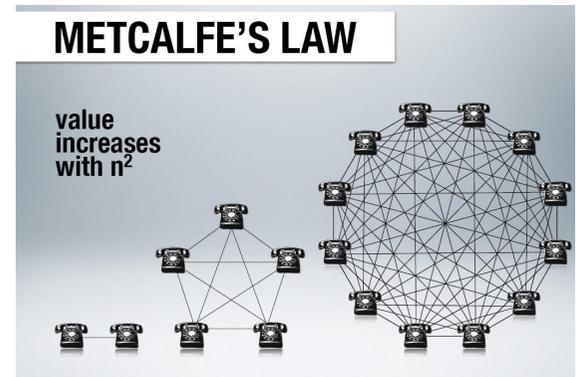Gordon Moore 1929-today. Cofounder of Fairchild in 1957 and Intel in 1968

SECOND MACHINE AGE

- Information and relations at the fingertips
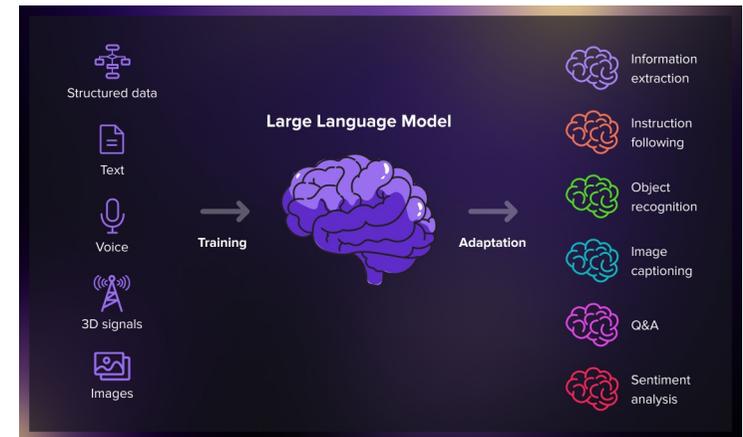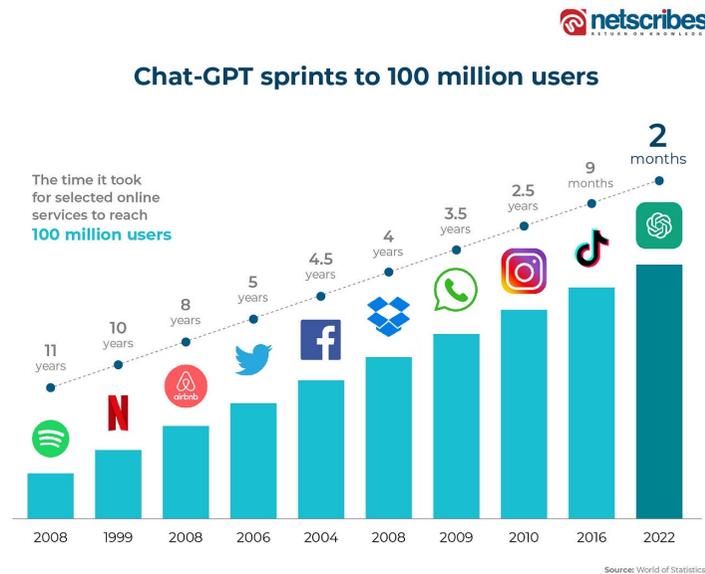

Bob Metcalfe co-creator of the Ethernet in 1974 at Xerox

| 1993 | 2005 | 2007 | 2010 | 2015 |

METCALFE'S LAW

value increases with n^2

THE THIRD MACHINE AGE

- "Skills at the fingertips" Satya Nadella, WEF Jan 2024
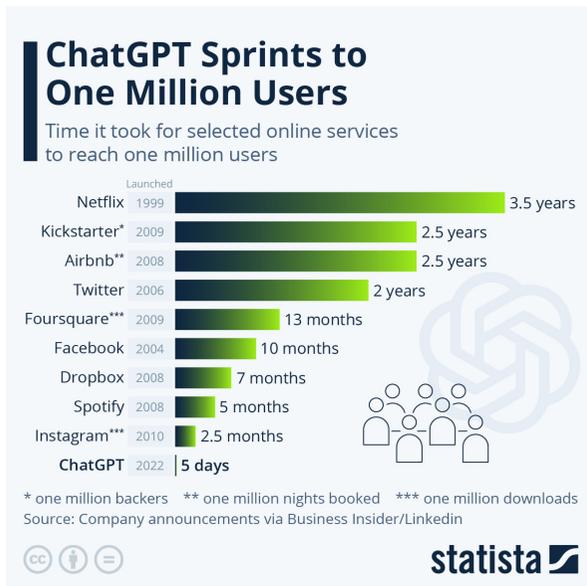
FROM BITS TO QUBITS

A binary digit, characterized as 0 or 1, is used to represent information in classical computers.

There are two possible outcomes for the measurement of a qubit—usually taken to have the value "0" and "1", like a bit or binary digit. However, whereas the state of a bit can only be either 0 or 1, the general state of a qubit according to quantum mechanics can be a coherent superposition of both. Moreover, whereas a measurement of a classical bit would not disturb its state, a measurement of a qubit would destroy its coherence and irrevocably disturb the superposition state.
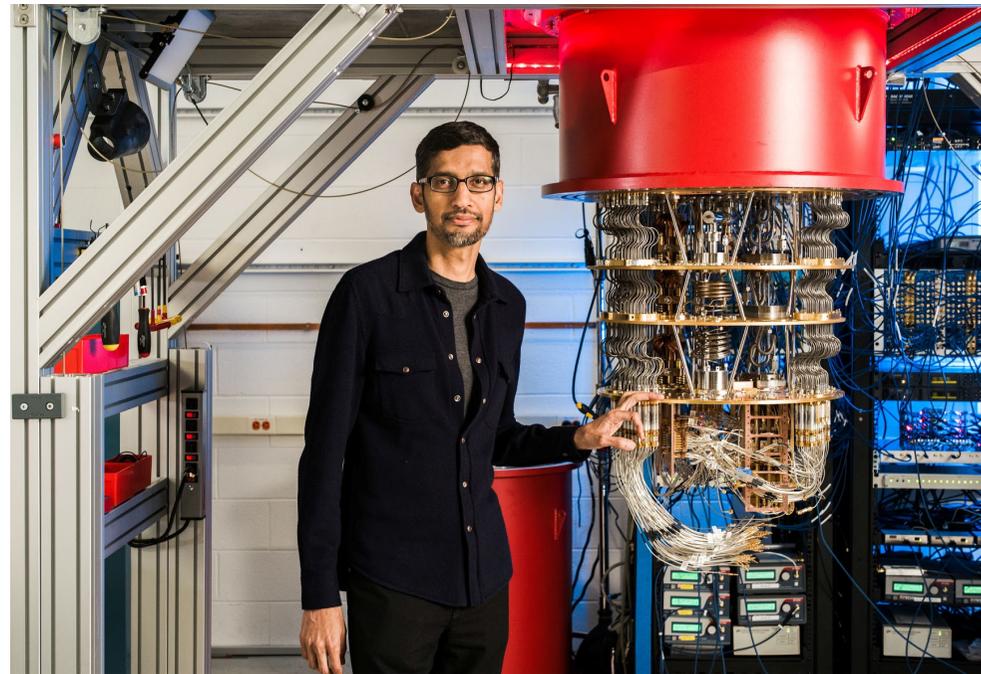
Sundar Pichai, CEO of Google, with a quantum computer

ORGANOIDS AND COMPUTING

Organic computing is computing that behaves and interacts with humans in an organic manner. The term "organic" is used to describe the system's behavior, and does not imply that they are constructed from organic materials. It is based on the insight that we will soon be surrounded by large collections of autonomous systems, which are equipped with sensors and actuators, aware of their environment, communicate freely, and organize themselves in order to perform the actions and services that seem to be required.

Organoid Applications
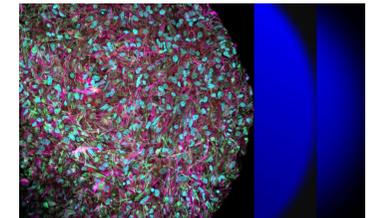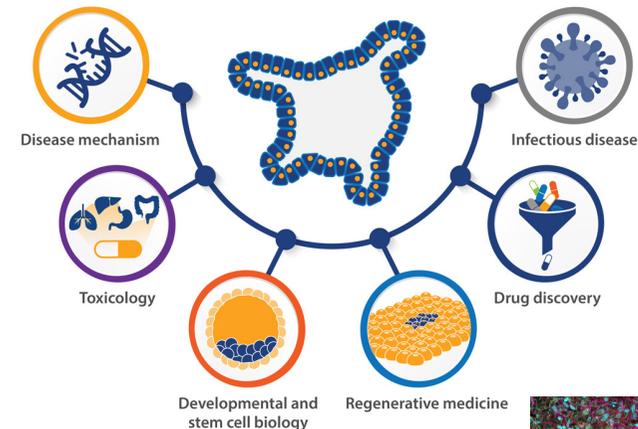
CrownBio
CONNECTING SCIENCE TO PATIENTS

Disease mechanism

Infectious disease

Toxicology

Drug discovery

Developmental and stem cell biology

Regenerative medicine

https://www.frontiersin.org/journals/science/article-hubs/organoid-intelligence-a-new-biocomputing-frontier/lay-summary

Agenda of my talk

1. Context: The third machine age
2. **Behavioral and economic Implications**
3. Education and technical change
4. Conclusions

DISRUPTION OF BEHAVIORS

"Many companies have us engaging in behaviors that would have seemed unthinkably foolhardy as recently as five years ago. We are hopping into strangers' cars (Lyft, Sidecar, Uber), welcoming them into our spare rooms (Airbnb), dropping our dogs off at their houses (DogVacay, Rover), and eating food in their dining rooms (Feastly). We are letting them rent our cars (RelayRides, Getaround), our boats (Boatbound), our houses (HomeAway), and our power tools (Zilok). *We are entrusting complete strangers with our most valuable possessions, our personal experiences - and our very lives*." (italics added)

(Wired, April 23 issue 2014).
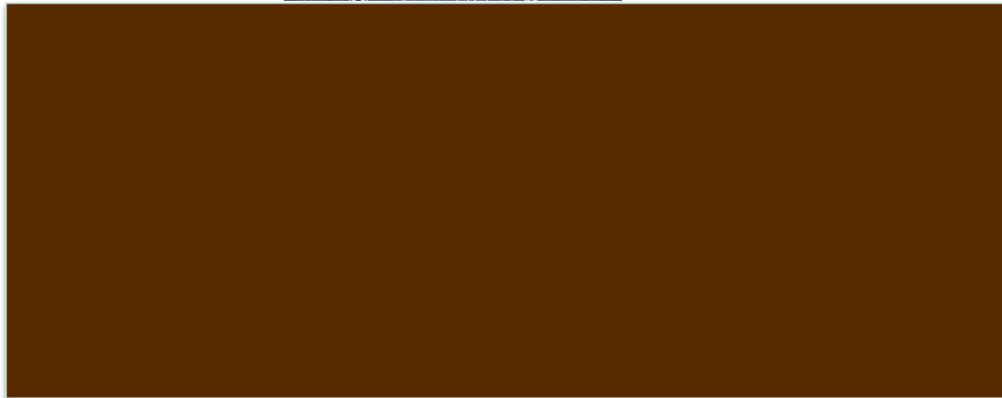
STUDENTS IN THE CLASSROOM
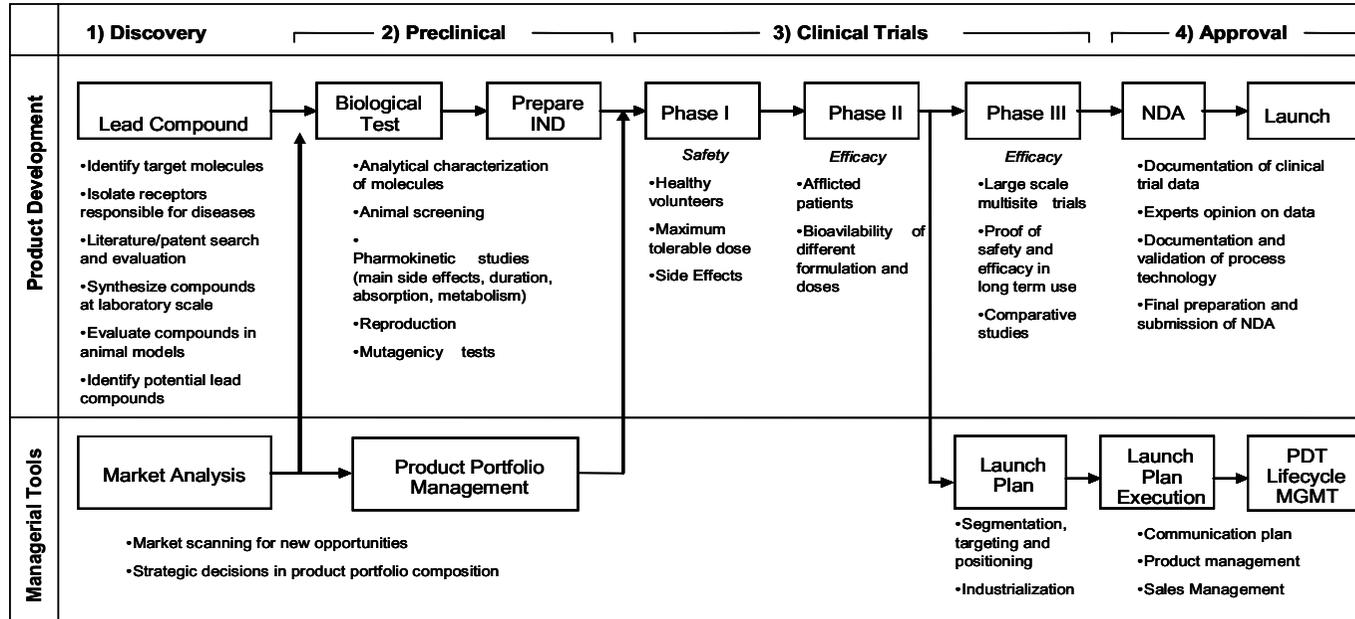
INDUSTRIES AND THE TECHNOLOGICAL CLIFF

Manufacturing ind   **Fintech**   **TV&Movies**   **Music**   **News**   **Retailing**

1) Discovery | **2) Preclinical** | **3) Clinical Trials** | **4) Approval**

Product Development

| Lead Compound | Biological Test | Prepare IND | Phase I | Phase II | Phase III | NDA | Launch |

Lead Compound
- Identify target molecules
- Isolate receptors responsible for diseases
- Literature/patent search and evaluation
- Synthesize compounds at laboratory scale
- Evaluate compounds in animal models
- Identify potential lead compounds

Biological Test / Prepare IND
- Analytical characterization of molecules
- Animal screening
- Pharmokinetic studies (main side effects, duration, absorption, metabolism)
- Reproduction
- Mutagenicy tests

Phase I
Safety
- Healthy volunteers
- Maximum tolerable dose
- Side Effects

Phase II
Efficacy
- Afflicted patients
- Bioavilability of different formulation and doses

Phase III
Efficacy
- Large scale multisite trials
- Proof of safety and efficacy in long term use
- Comparative studies

NDA / Launch
- Documentation of clinical trial data
- Experts opinion on data
- Documentation and validation of process technology
- Final preparation and submission of NDA

Managerial Tools

| Market Analysis | Product Portfolio Management | Launch Plan | Launch Plan Execution | PDT Lifecycle MGMT |

Market Analysis / Product Portfolio Management
- Market scanning for new opportunities
- Strategic decisions in product portfolio composition

Launch Plan
- Segmentation, targeting and positioning
- Industrialization

Launch Plan Execution / PDT Lifecycle MGMT
- Communication plan
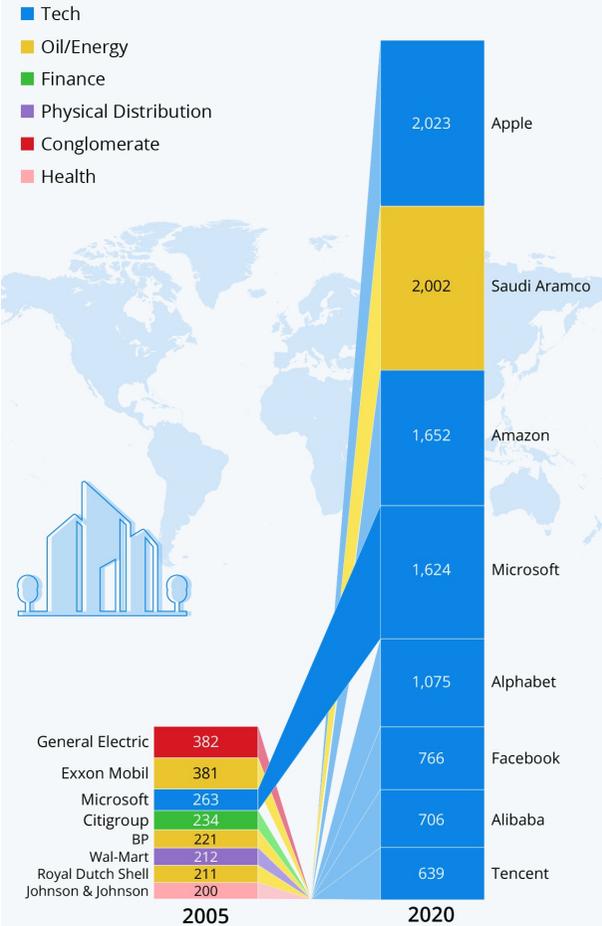- Product management
- Sales Management

ECONOMIC IMPACT

The Age of the Tech Giants

Companies with the world's largest market capitalizations in 2005 and 2020 (in billion U.S. dollars)*

- ■ Tech
- ■ Oil/Energy
- ■ Finance
- ■ Physical Distribution
- ■ Conglomerate
- ■ Health

2005
Company	Value
General Electric	382
Exxon Mobil	381
Microsoft	263
Citigroup	234
BP	221
Wal-Mart	212
Royal Dutch Shell	211
Johnson & Johnson	200

2020
Company	Value
Apple	2,023
Saudi Aramco	2,002
Amazon	1,652
Microsoft	1,624
Alphabet	1,075
Facebook	766
Alibaba	706
Tencent	639

* As of March 31, 2005 and August 20, 2020.
Sources: Financial Times, Yahoo! Finance

statista ◢

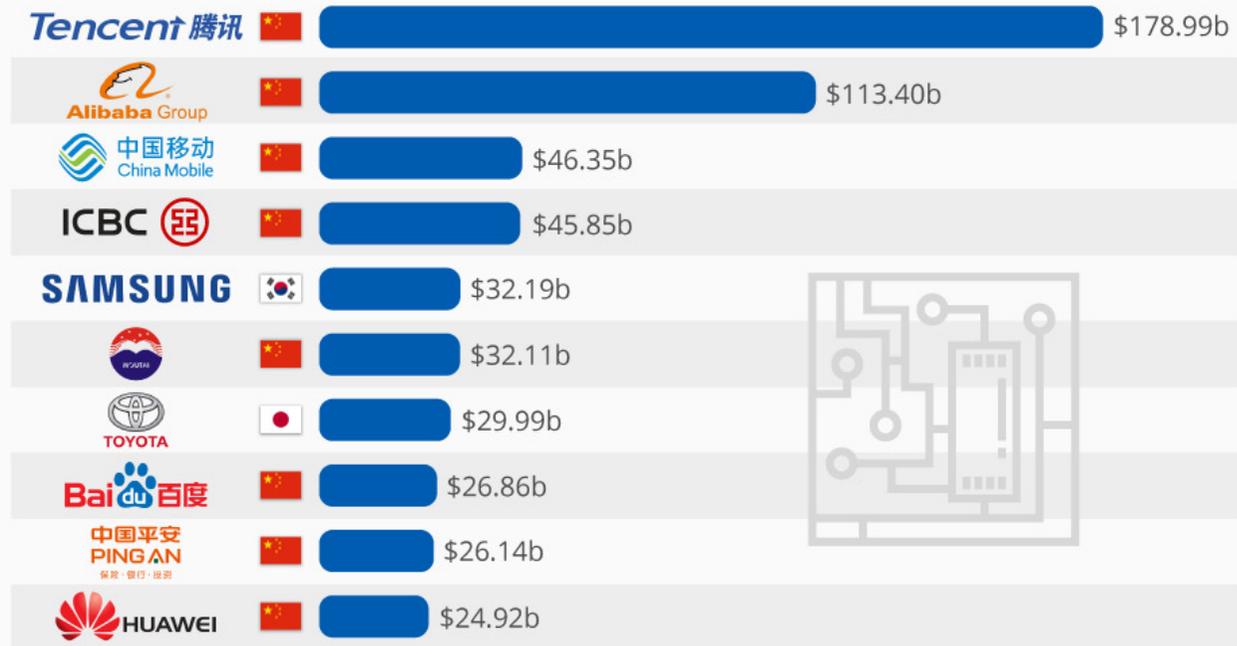# CONTINUES

$3 trillion

Microsoft

Apple

Nvidia

2

1
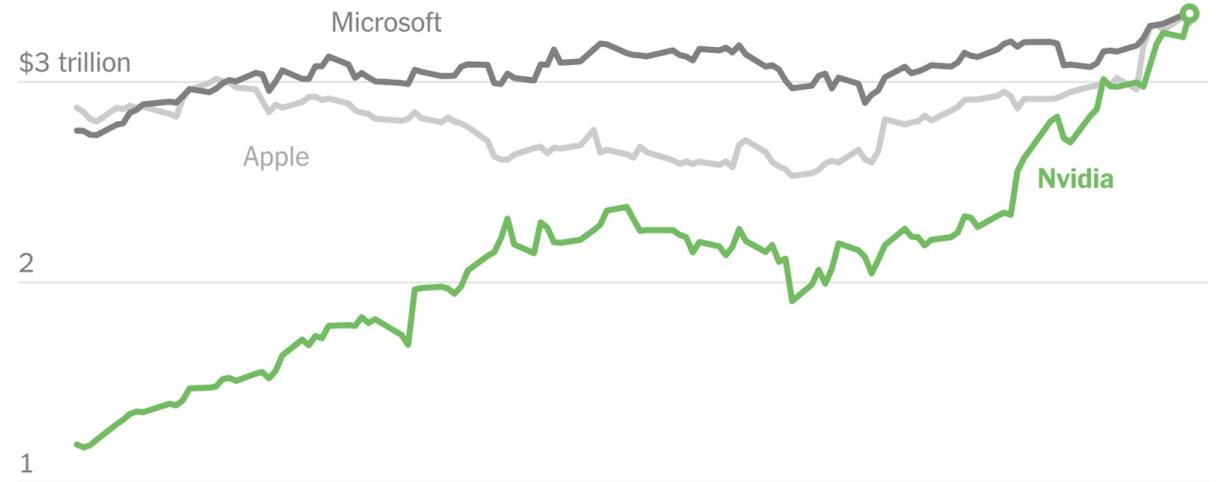
Market Value Since the Beginning of the Year

Chinese tech giants lead Asia's top 10 brands
Top 10 most valuable corporate brands in Asia as of May 2018*

Brand	Value
Tencent 腾讯	$178.99b
Alibaba Group	$113.40b
中国移动 China Mobile	$46.35b
ICBC	$45.85b
SAMSUNG	$32.19b
(China)	$32.11b
TOYOTA	$29.99b
Baidu 百度	$26.86b
中国平安 PING AN	$26.14b
HUAWEI	$24.92b

* Value has been rounded.
@StatistaCharts   Source: Kantar Millward Brown

statista

COLD WAR 2.0

# MORE IMPORTANTLY: WORK AND DIVIDE

When Workers Began Falling Behind

Until the 1980s labor productivity, real GDP per capita, private employment, and median family income all rose in tandem in the U.S. Then median income started to trail, and around 2000 job growth slowed.

Labor productivity

Real GDP per capita

Private employment

Median family income

400

300

200

1947=100

1950 '55 '60 '65 '70 '75 '80 '85 '90 '95 2000 '05 '10
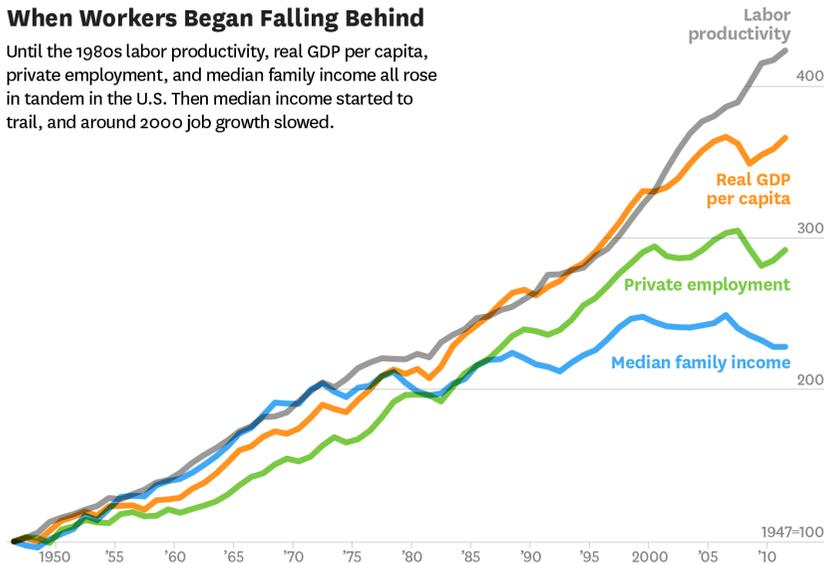
SOURCE FEDERAL RESERVE BANK OF ST. LOUIS; ERIK BRYNJOLFSSON AND ANDREW MCAFEE
FROM "THE GREAT DECOUPLING," JUNE 2015

© HBR.ORG

«The great decoupling»
Brynjolfsson and McAfee 2015

CAPITAL
in the Twenty-First Century

THOMAS PIKETTY

TRANSLATED BY ARTHUR GOLDHAMMER
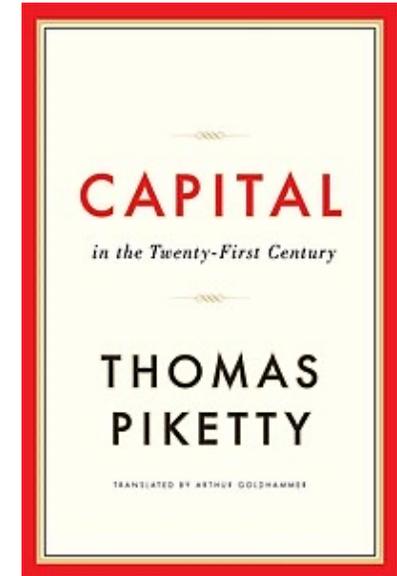
Thomas Piketty (above) e Claudia Goldin (below)

Agenda of my talk

1. Context: The third machine age
2. Behavioral and economic implications
3. **Education and technical change**
4. Conclusions

AI IN THE CLASSROOM

Would Chat GPT Get a Wharton MBA?

CHRISTIAN TERWIESCH

https://mackinstitute.wharton.upenn.edu/2023/would-chat-gpt3-get-a-wharton-mba-new-white-paper-by-christian-terwiesch/

CONTENT: STEM AND INTERDISCIPLINARITY

- More STEM: From kindergarten to 12

- More modularity of learning in high school:
  - Humanities with STEM and STEM with humanities

- More interdisciplinary curricula at the university level
  - Depth of knowledge but also breadth
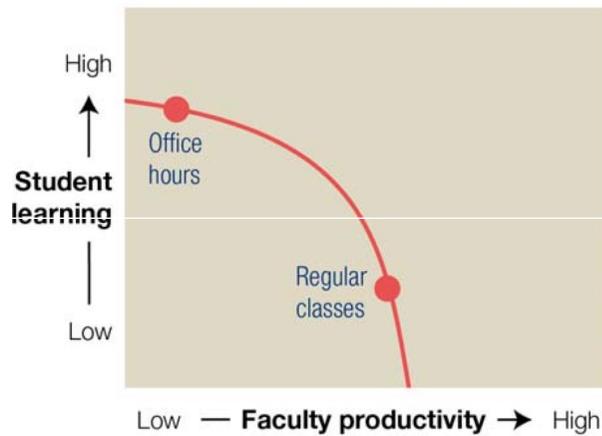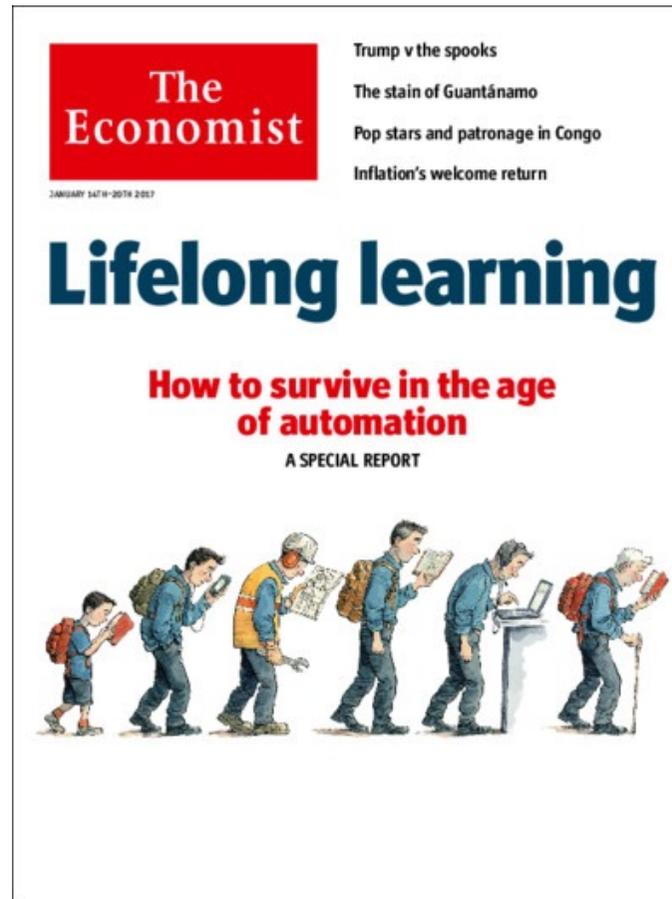
PROCESS: FLIPPED CLASSROOM?

KARL ULRICH

CHRISTIAN TERWIESCH

http://mackinstitute.wharton.upenn.edu/2014/will-video-kill-classroom-star/
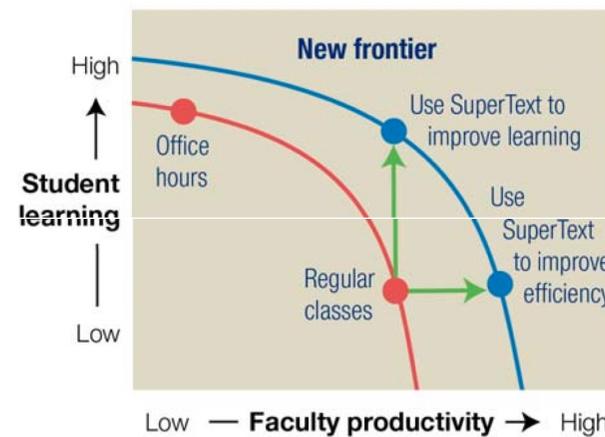
NEETS AND WORKERS: TRAINING!

Agenda of my talk

1. Context: The third machine age
2. Behavioral and economic implications
3. Education and technical change
4. **<u>Conclusions</u>**

TO CONCLUDE

- History tells us that waves of technological change are unstoppable (although governable)
- We are living a third machine age which opens opportunities but also important caveats
- In addition to direct regulation through EU, it is also crucial to provide the right incentive to people and firms to innovate
- With regard to education, revising curricula to inject more STEM and interdisciplinarity and the classroom experience is a great starting point
- Supporting training for NEETS and in general seniors will be as much as important

Thank you!
Questions?
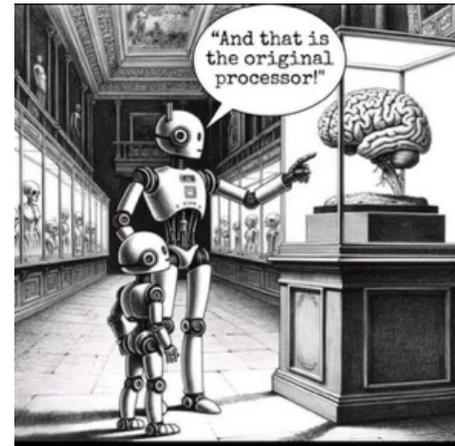
gianmario.verona@unibocconi.it
Linkedin Gianmario Verona