Artificial Intelligence:
The race with the machine

Prof. Nicolas van Zeebroeck
Assuralia
December 2024

AI raises big promises…

Copilot boosts programmers' productivity by **55%** (Peng et al., 2023)

Generative AI will raise global GDP by **$7 trillion** worldwide (Goldman Sachs, 2023)

VIDÉO CANAL Z

Selon Google, l'IA pourrait doper le PIB belge de 50 milliards d'euros !

Canal Z

12-03-2024, 18:05 • Mise à jour le: 12-03-2024, 19:48 •

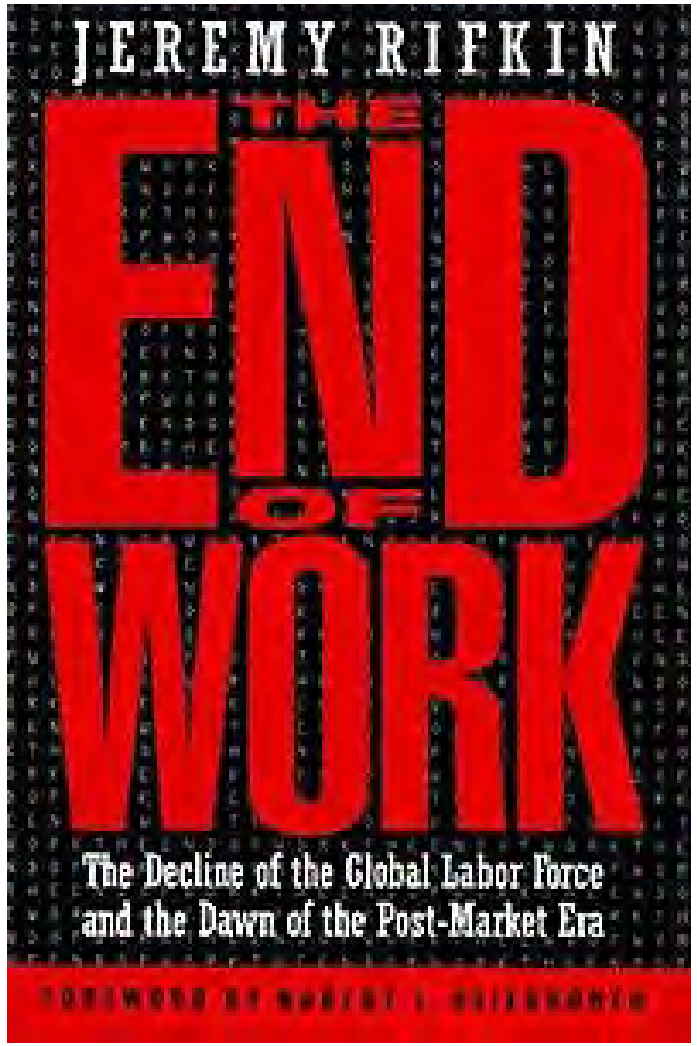
Les chiffres liés au développement de l'intelligence artificielle donnent le tourni. Selon la dernière étude menée par Implement Consulting Group pour le compte de Google, entre 20 à 30 % des activités professionnelles belge pourraient déjà être automatisées aujourd'hui grâce à l'IA générative. Avec à la clé un énorme gain de productivité estimé à 9% du pib.

TECHNOLOGY NEWS JANUARY 18, 2016 / 9:05 AM / 3 YEARS AGO

Robots, new working ways to cost five million jobs by 2020, Davos study says

3 MIN READ

DAVOS, Switzerland (Reuters) - Disruptive labor market changes, including the rise of robots and artificial intelligence, will result in a net loss of 5.1 million jobs over the next five years in 15 leading countries, according to an analysis published in Davos on Monday.



Artificial Intelligence WARNING: Can intelligent robots replace human jobs by 2025?

ARTIFICIALLY intelligent robots could trigger a "fourth industrial revolution" and displace more than half of the human workforce by 2025, a Swiss think-tank has warned.

By SEBASTIAN KETTLEY
PUBLISHED: 16:39, Mon, Sep 17, 2018 | UPDATED: 16:51, Mon, Sep 17, 2018

Forbes

FORBES > LEADERSHIP > CAREERS

EDITORS' PICK

Goldman Sachs Predicts 300 Million Jobs Will Be Lost Or Degraded By Artificial Intelligence

4,037 views | Sep 5, 2018, 10:56pm

Robots Will Take Our Jobs And We Need A Plan: 4 Scenarios For The Future

Blake Morgan Contributor
CMO Network
Customer Experience Futurist, Author, Keynote Speaker


Let’s take a closer look

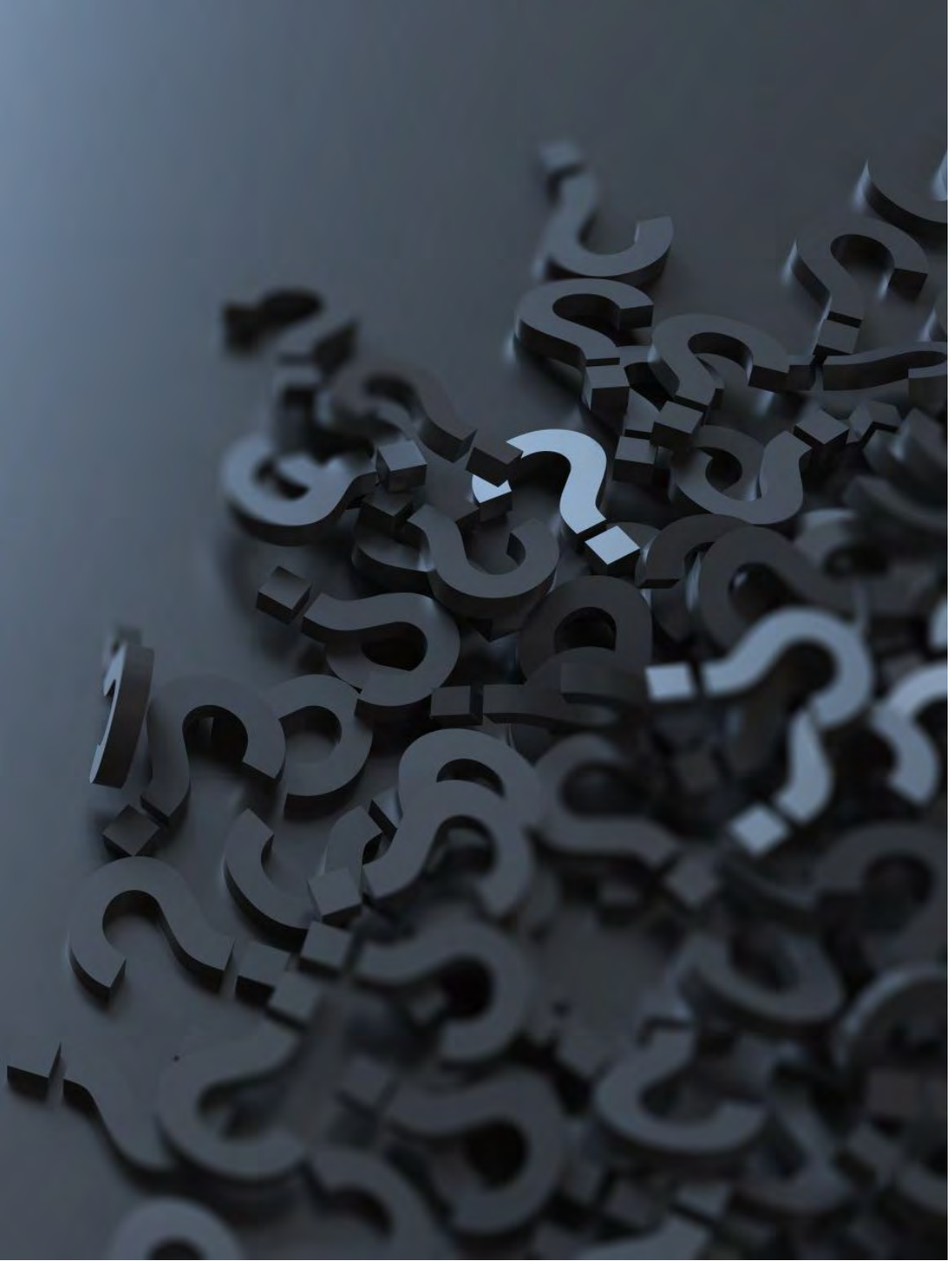
AI = Technologies that reproduce cognitive functions

Communicate	→ Natural language processing
Memorize	→ Knowledge representation
Answer questions, draw conclusions	→ Automated reasoning
Imagine, create	→ Computational creativity
Adapt	→ Machine learning
Perceive	→ Computer vision
Manipulate objets	→ Robotics

Source: Russel & Norvig (2016) & Lenaerts (2018)

AI = MAKING PREDICTIONS BASED ON EXISTING DATA

- Fully generic (can be applied to anything)
- Will entirely depend on what you do with it

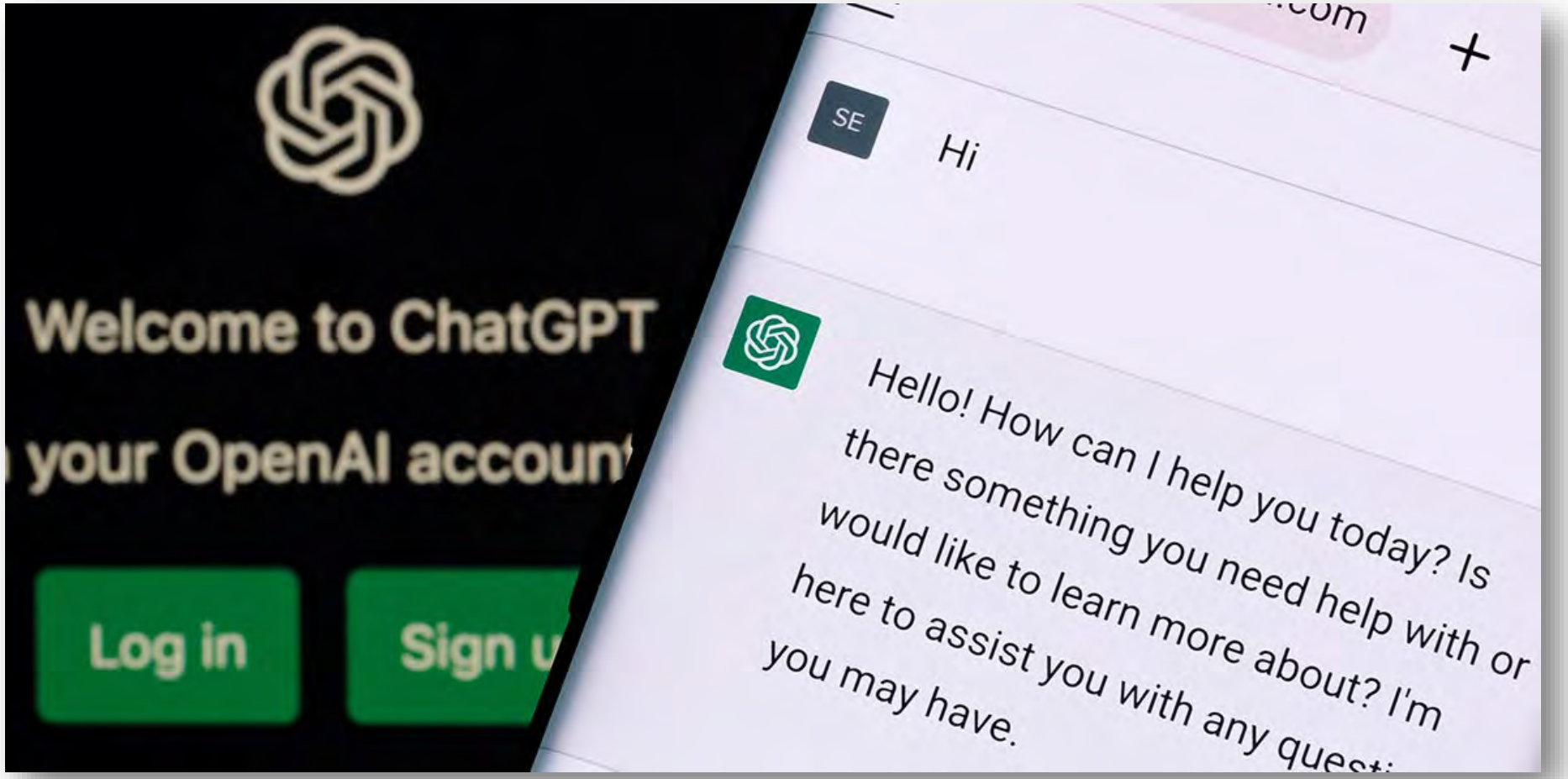


Questions to look at

- Is firm-level AI adoption easy and massive?
- Can AI adoption boost productivity and performance?
- Should we fear for jobs?
- Can firms and the EU afford to miss the AI train?
- (What) do we need to regulate?


Is firm-level AI adoption so massive?

ChatGPT has made adoption easy…
… for individual tasks/use cases



In the workplace, 75% knowledge workers use Gen AI…

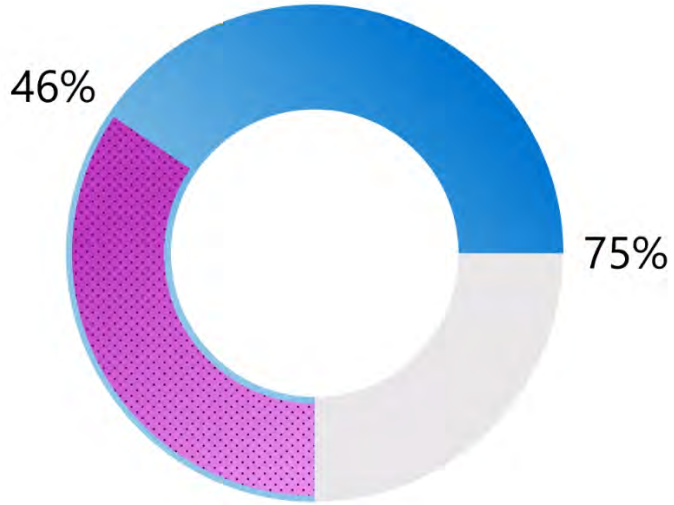
Source: Microsoft & LinkedIn 2024 Work Trend Index Annual Report

Three Out of Four People Use AI at Work

Usage nearly doubled in the last six months.

75% of people are already using AI at work

46% of them started using it less than 6 months ago



Survey Questions:

How often do you use generative artificial intelligence (AI) for your work?

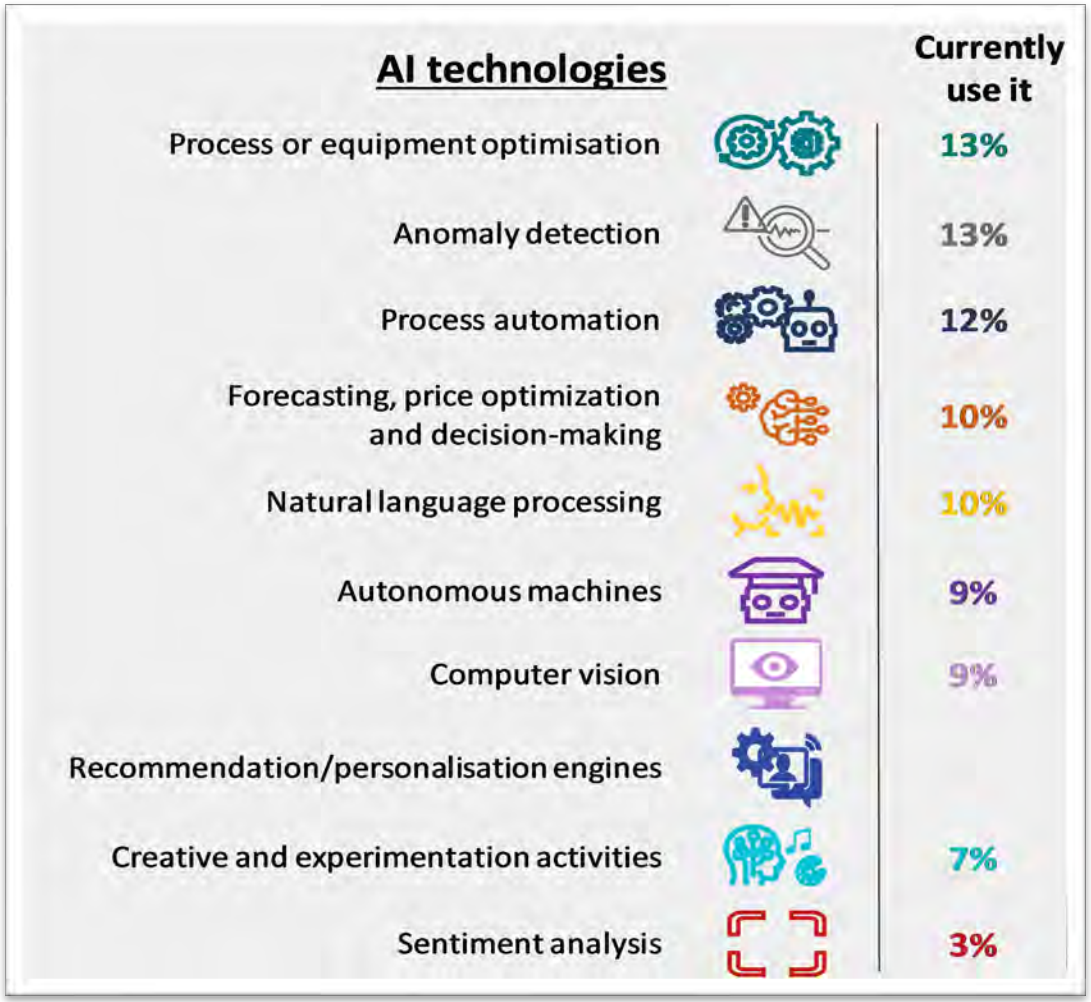
How long have you been using generative artificial intelligence (AI) at work?

…but not from their employer

78% of AI users are bringing their own AI tools to work (BYOAI)

Source: Microsoft & LinkedIn 2024 Work Trend Index Annual Report

Firm-level adoption of AI is very slow



Source: ULB/Solvay survey for the EC Commission (2020)
(Similar observations in the US (McElheran et al. 2021))

Figure 3.10. **Adoption of data-driven technologies remains low**

Adoption rates of cloud computing, IoT technologies, big data analytics and AI by enterprises with ten employees or more in the business sector (excluding financial services), 2023 (or most recent)

AI Adoption among firms is slow…

"just 11% of companies have adopted gen AI at scale" (McKinsey 2024)

Source: OECD Digital Economy Outlook 2024


How to resolve
this paradox?

Barriers to AI adoption are huge

Internal obstacles	Overall	Adopters	Non-adopters	Plan to use
Difficult to hire new staff with the right skills	57%	57%	57%	61%
The cost of adoption	52%	48%	56%	57%
The cost of adapting operational processes	49%	44%	53%	55%
Lack of skills among existing staff	45%	38%	50%	55%
Complex algorithms are difficult to understand and trust	40%	35%	44%	44%
Insufficient or incompatible IT infrastructure	36%	29%	42%	42%
Lack of internal data	20%	17%	24%	23%

Source: ULB/Solvay survey for the EC Commission (2020)

A long way to go from discrete tasks to integrated processes

Jobs and processes are bundles of tasks

A task is not a job

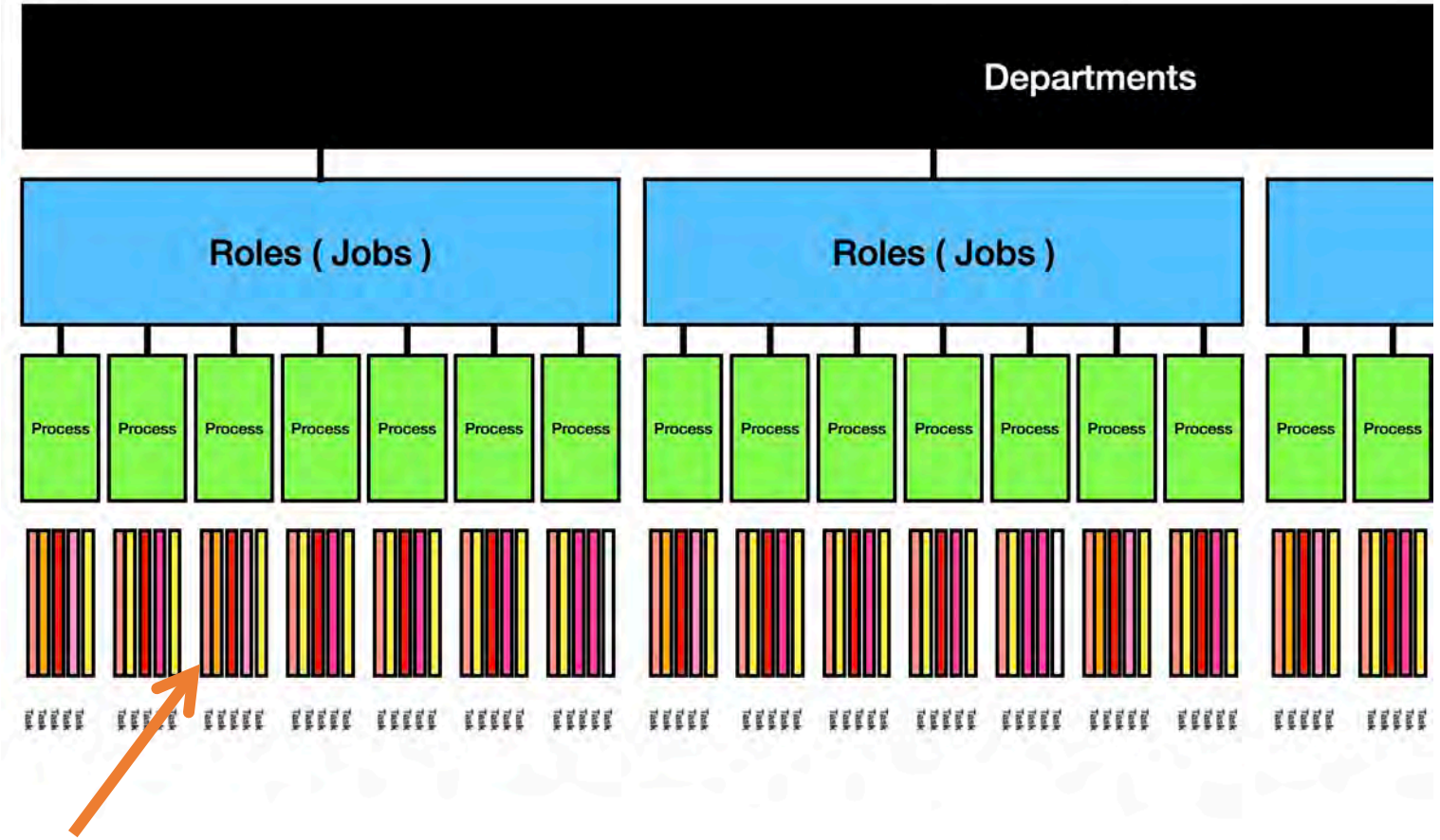
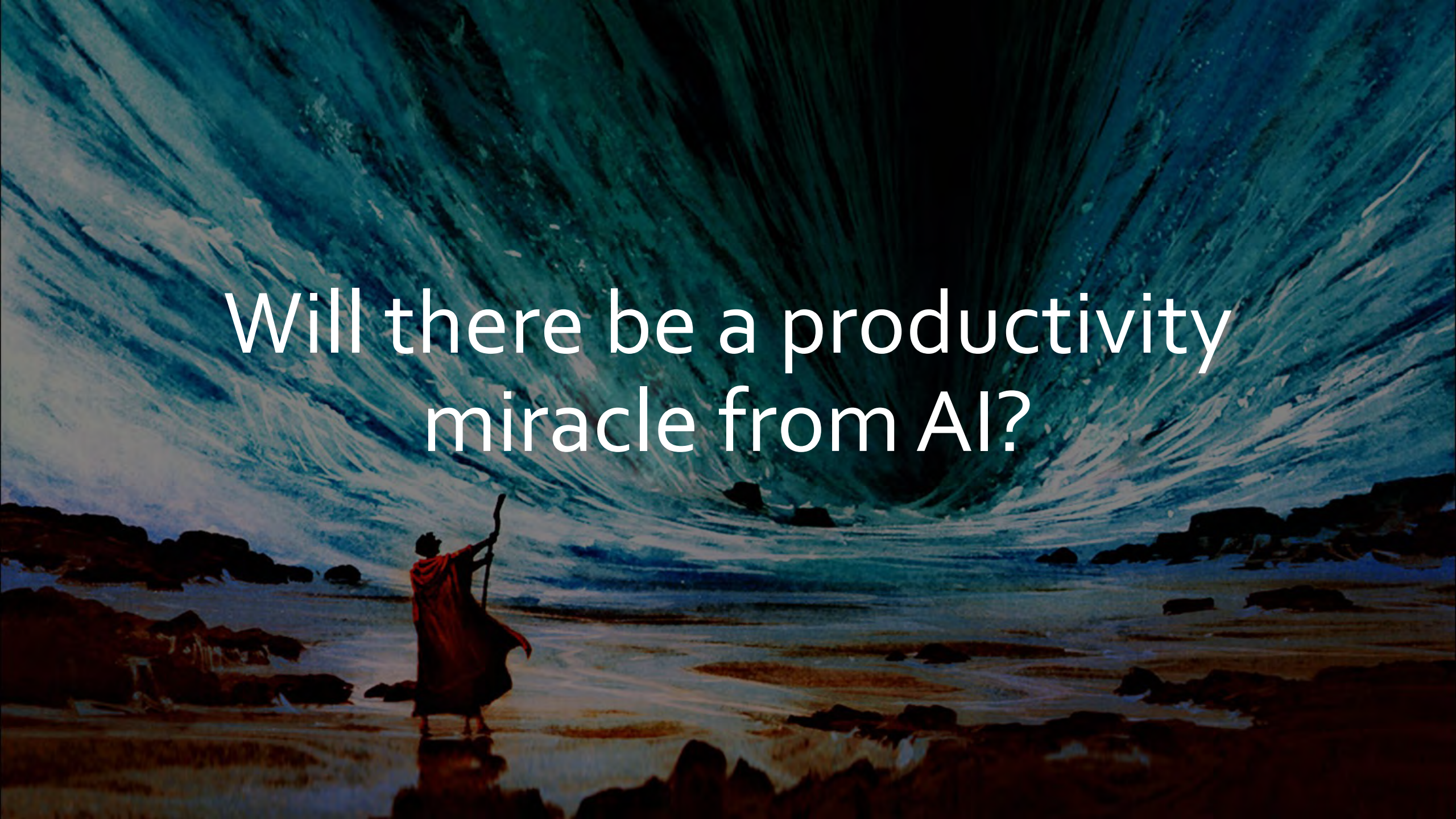


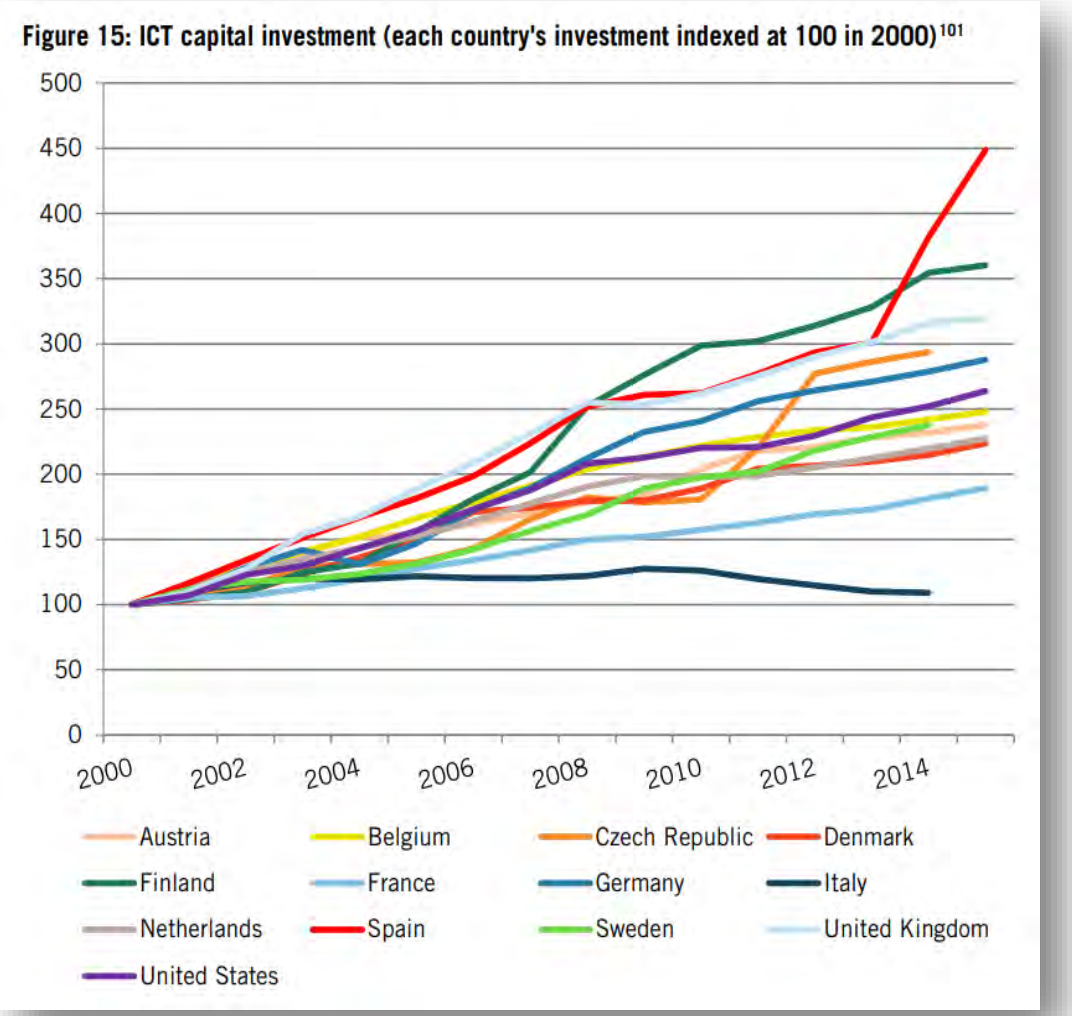
Illustration from https://www.linkedin.com/posts/tomfgoodwin_this-is-why-ai-wont-take-your-job-ai-is-activity-7169009404049108995-atEk/

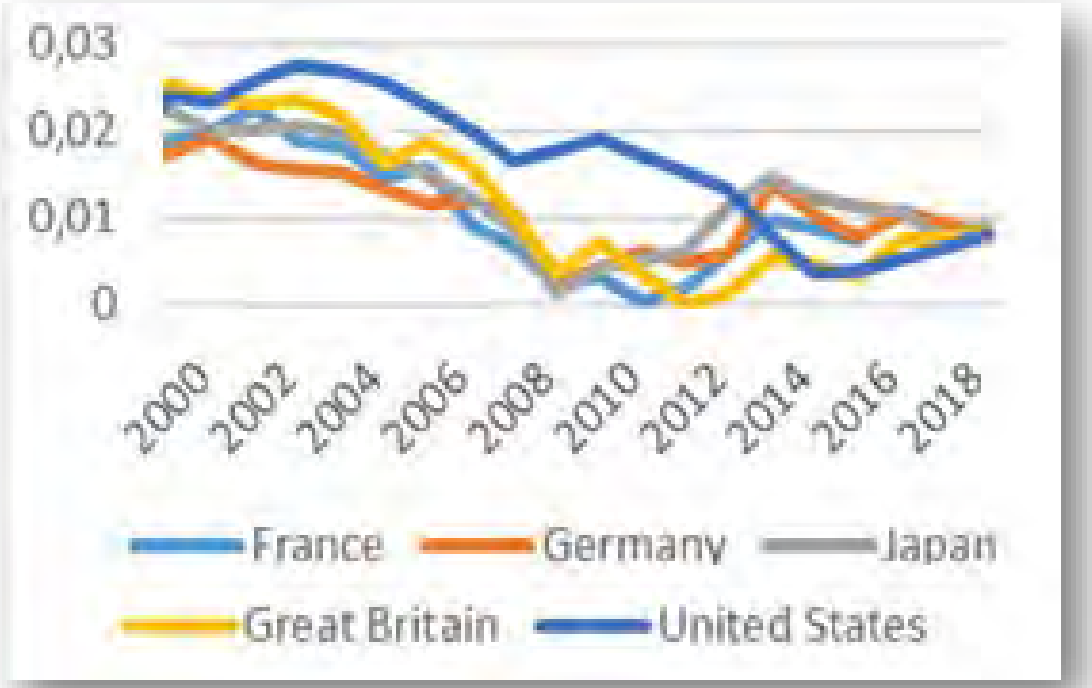
Exploiting digital & AI at scale requires time and new processes


AI adoption among firms is much slower
and harder than one may think
(no need to make it even harder)


Will there be a productivity miracle from AI?

Digital has failed so far to boost productivity (at economy-level)

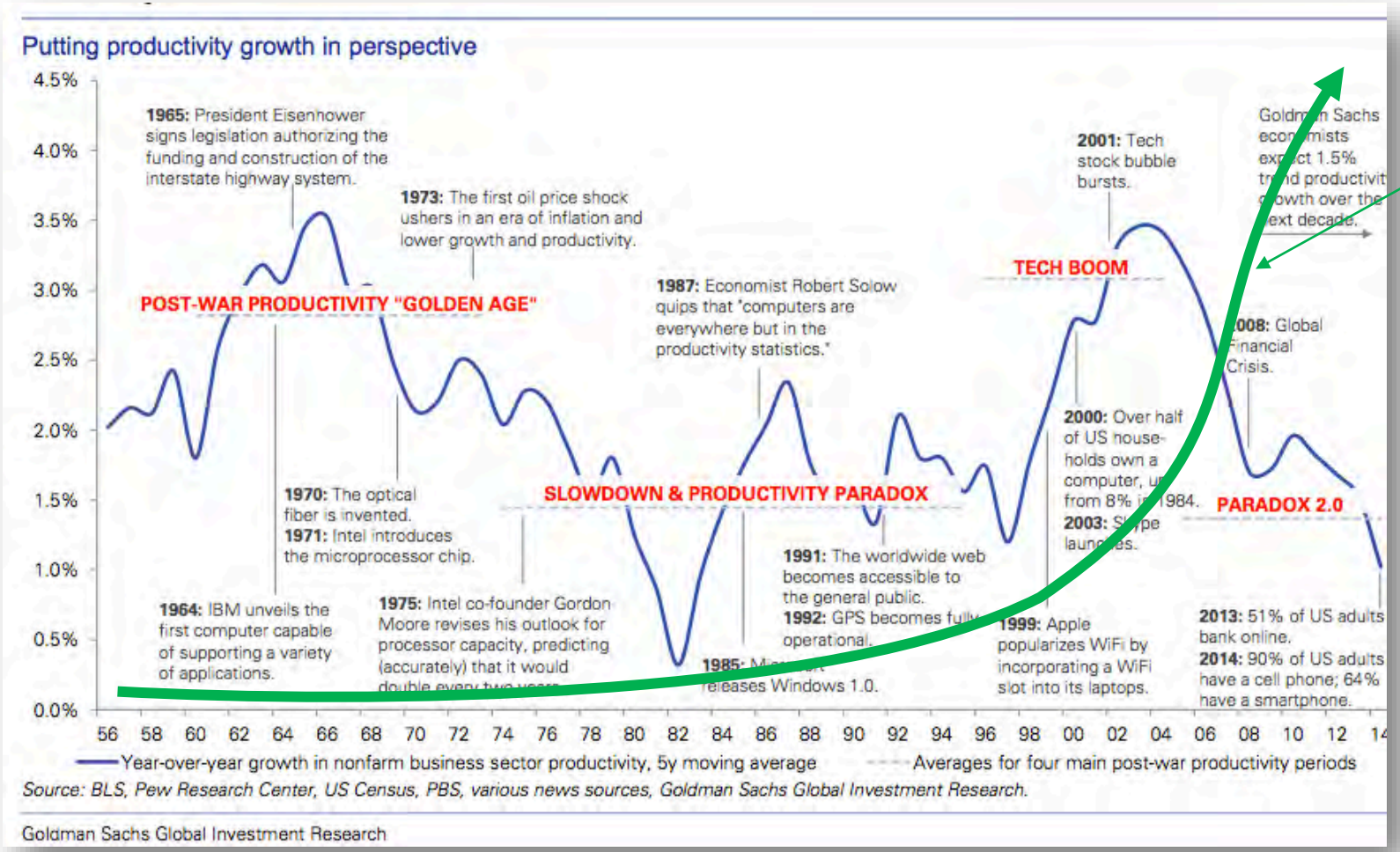




Rate of growth of labor productivity, 5 year moving average

Sources: Lapavitsas (2022) and https://www2.itif.org/2018-ict-eu-productivity-growth.pdf

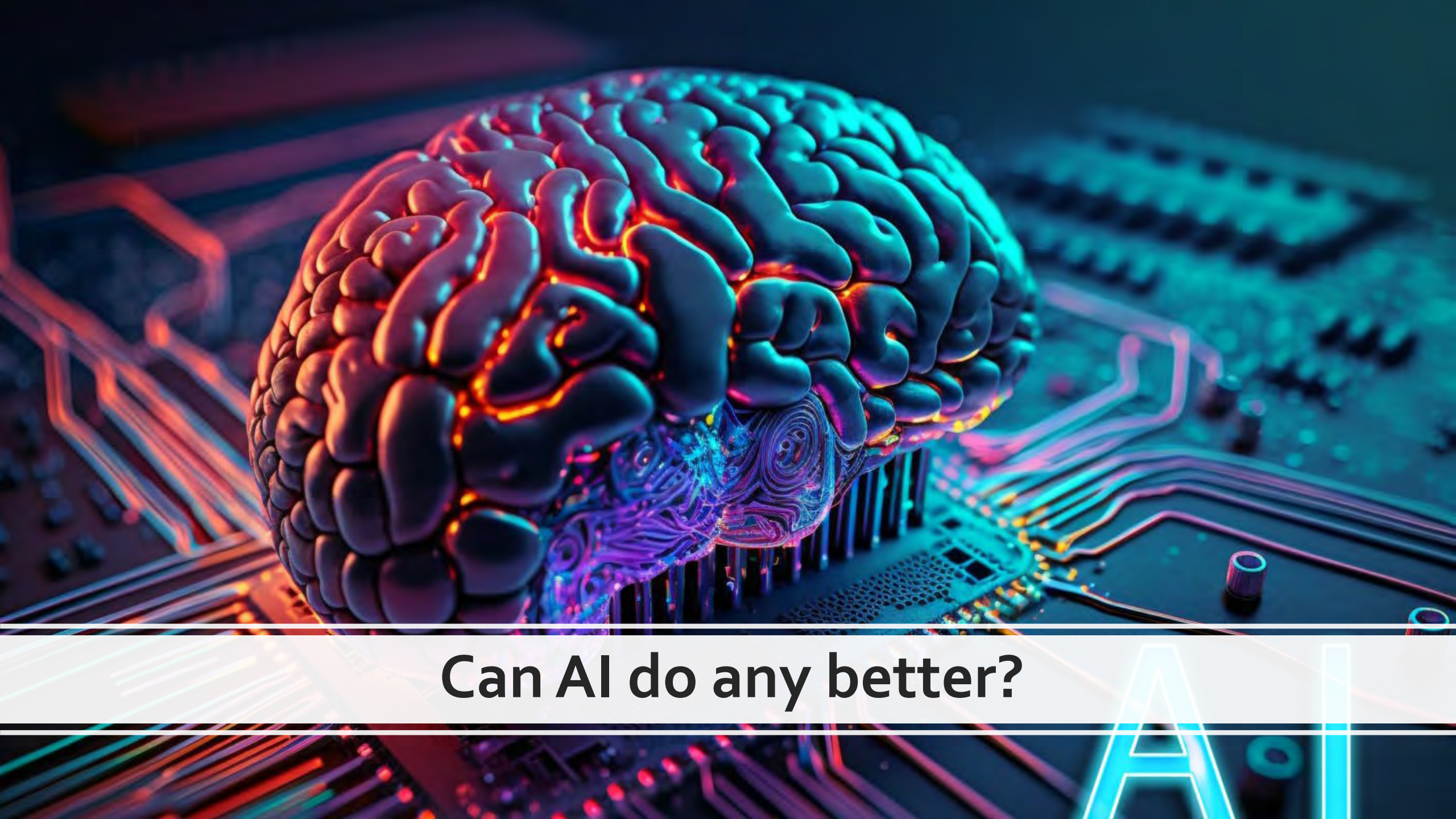
Digital has failed so far to boost productivity



Corporate investments in ICT

"One can see computers everywhere, except in productivity statistics."

Solow, 1987



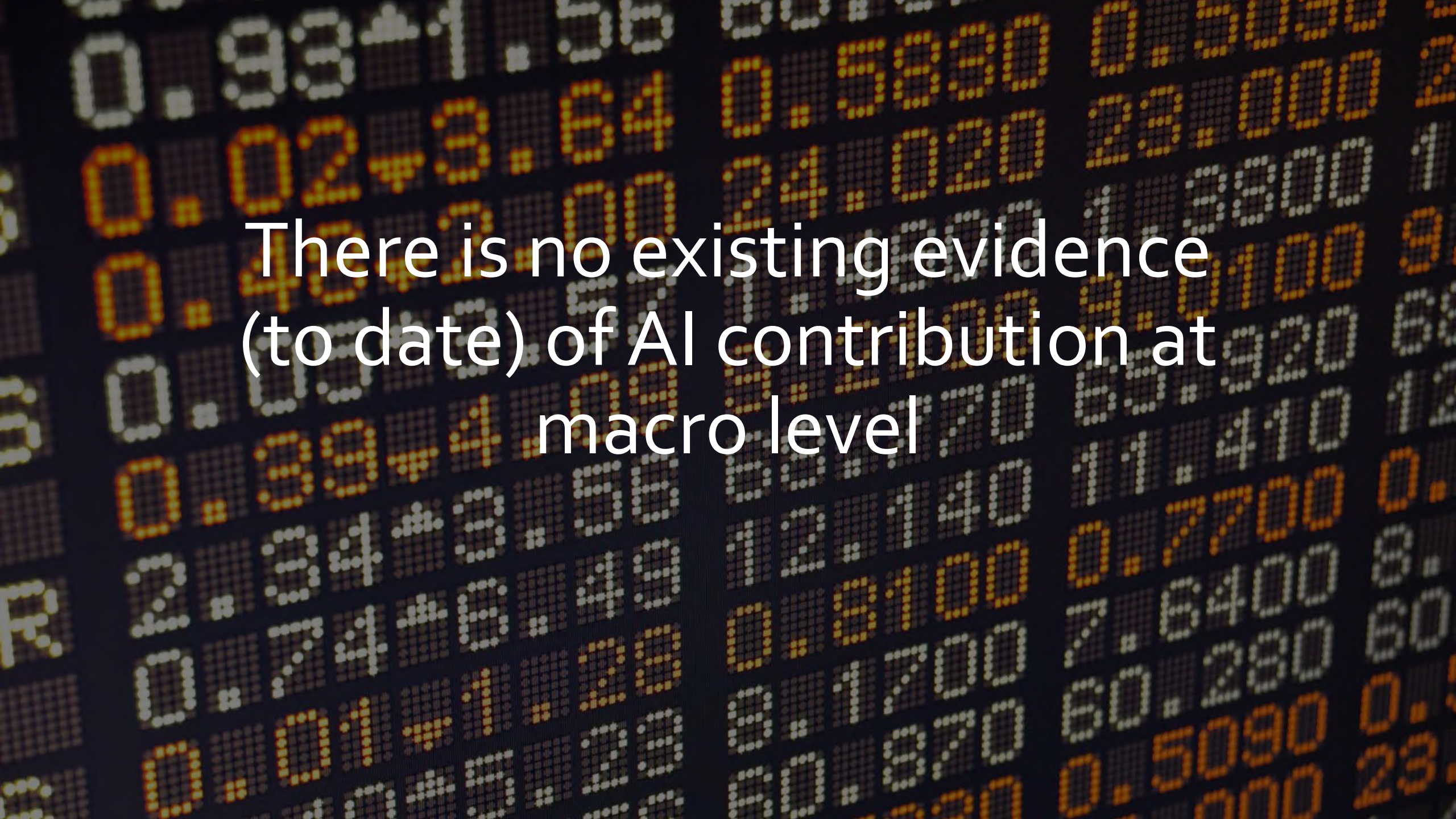
Can AI do any better?

At first sight, fresh econ research suggests significant contribution of AI… at TASK level

Paper	Field	AI Technology	Productivity gain
Noy and Zhang, 2023	Writing tasks	ChatGPT	+40%
Brynjolfsson, Li and Raymond, 2023	Call center tasks	Chatbot	+14%
Kanazawa et al., 2022	Taxi drivers cruising task	AI Routing	+14%
Dell'Acqua et al., 2023	Consulting tasks	ChatGPT	+25%
Gao and Feng, 2023	Cross-firm	AI	+14%

Forbes

AI Stats News: 65% Of Companies Have Not Seen Business Gains From Their AI Investments

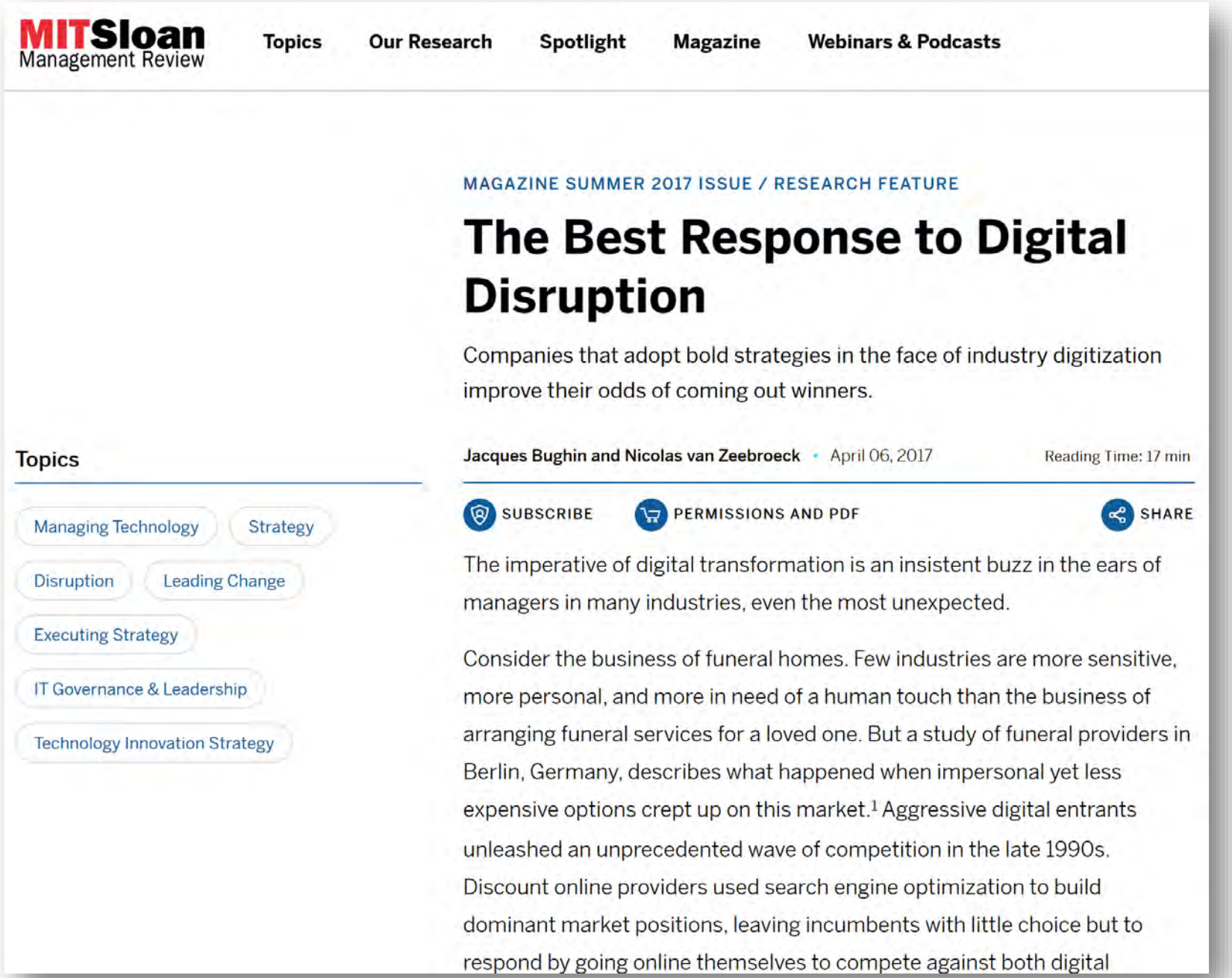

There is no existing evidence (to date) of AI contribution at macro level

Without the proper foundations & governance the odds of failure are high!

70%

Digital doesn't pay off without organizational capital and strategic change…

But gains can be huge for those who succeed!



MITSloan Management Review

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MAGAZINE SUMMER 2017 ISSUE / RESEARCH FEATURE

The Best Response to Digital Disruption

Companies that adopt bold strategies in the face of industry digitization improve their odds of coming out winners.

Topics

Managing Technology | Strategy | Disruption | Leading Change | Executing Strategy | IT Governance & Leadership | Technology Innovation Strategy

Jacques Bughin and Nicolas van Zeebroeck • April 06, 2017 Reading Time: 17 min

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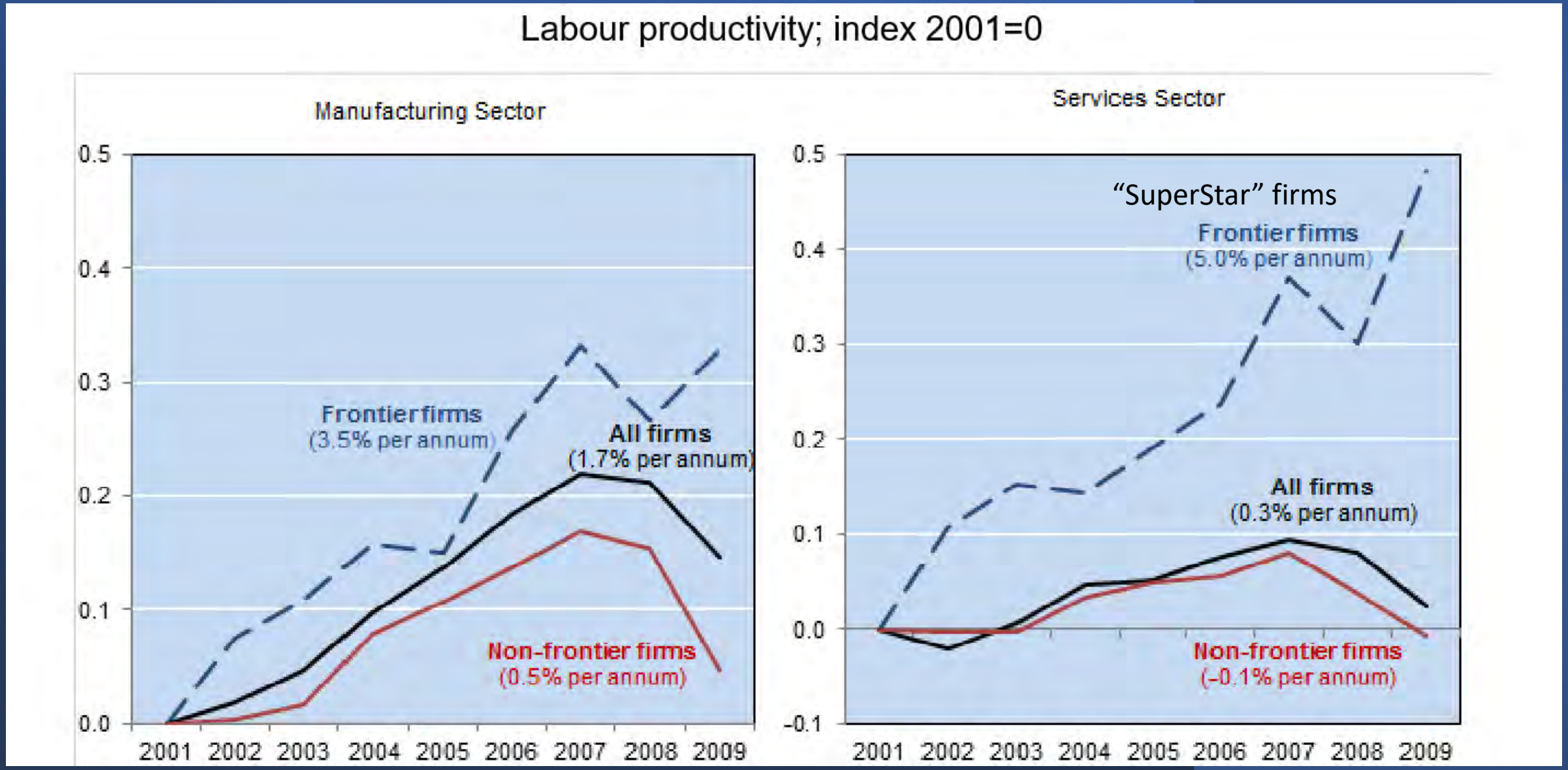
The imperative of digital transformation is an insistent buzz in the ears of managers in many industries, even the most unexpected.

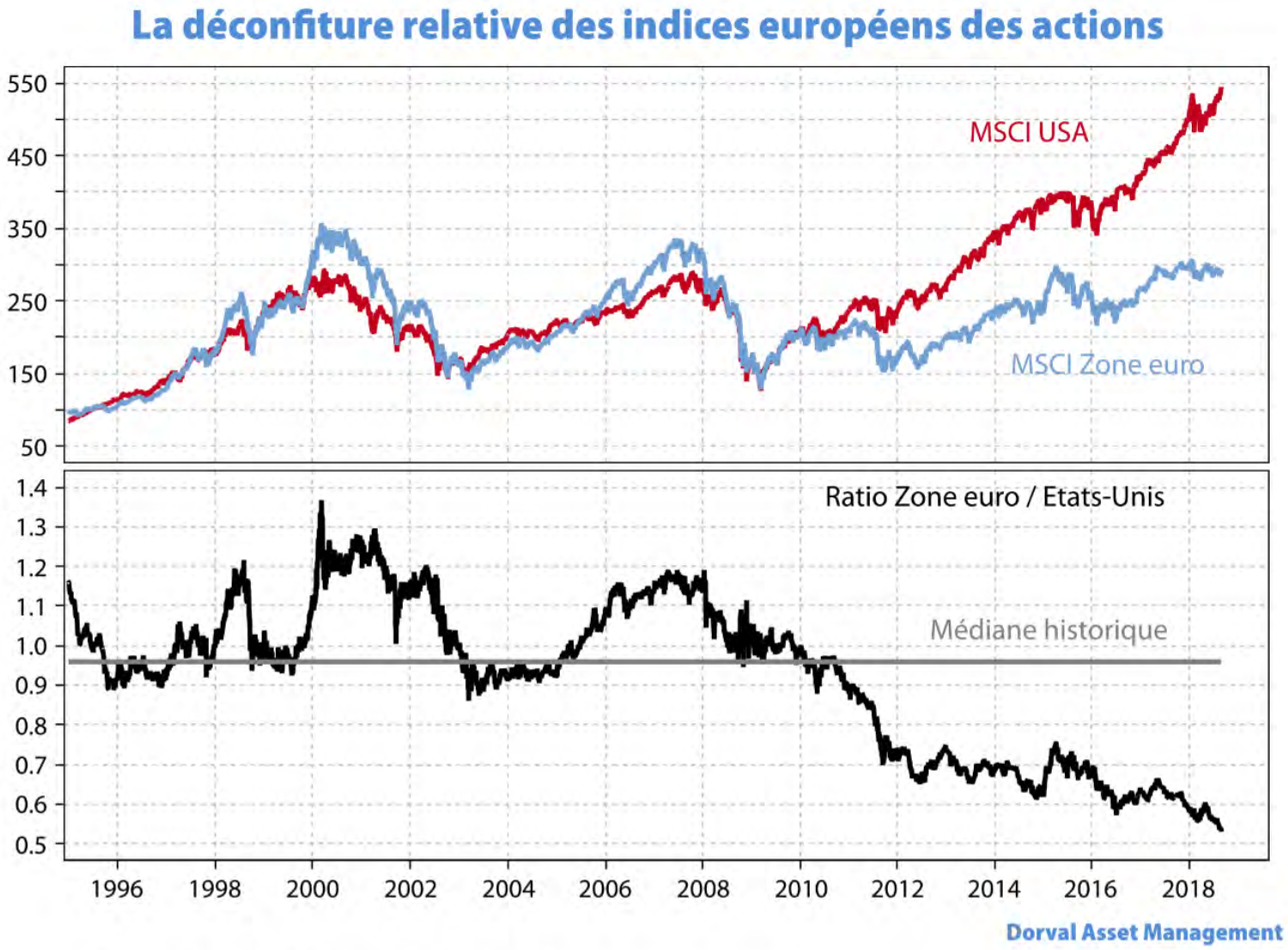
Consider the business of funeral homes. Few industries are more sensitive, more personal, and more in need of a human touch than the business of arranging funeral services for a loved one. But a study of funeral providers in Berlin, Germany, describes what happened when impersonal yet less expensive options crept up on this market.[1] Aggressive digital entrants unleashed an unprecedented wave of competition in the late 1990s. Discount online providers used search engine optimization to build dominant market positions, leaving incumbents with little choice but to respond by going online themselves to compete against both digital

Will this lead to a winner-takes-all situation?



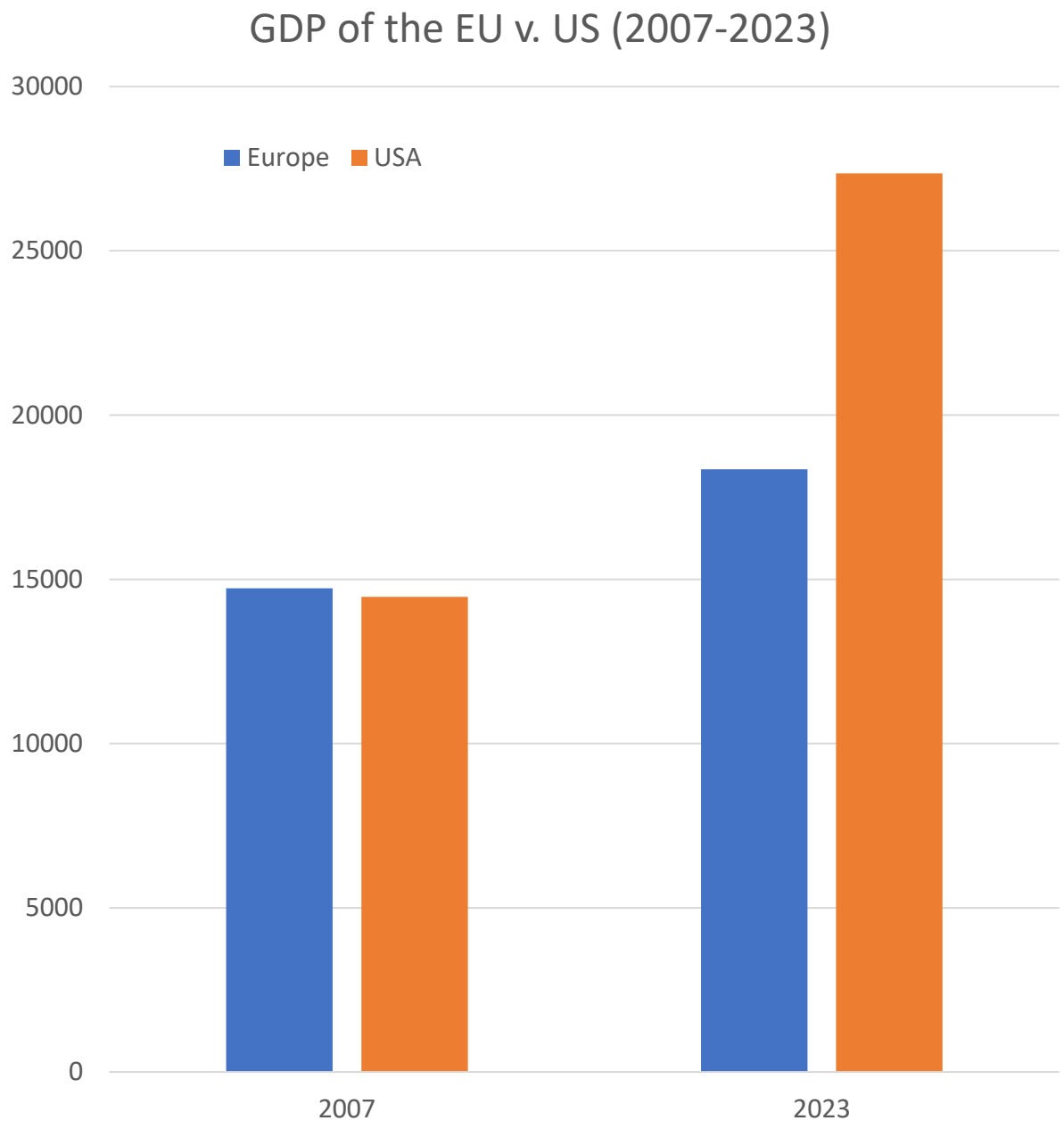
Source: OECD 2015

Does value flee Europe?



Sources : MSCI, Macrobond

Is Europe falling behind?



Americans do IT better…

American Economic Review

ISSN 0002-8282 (Print) | ISSN 1944-7981 (Online)

Americans Do IT Better: US Multinationals and the Productivity Miracle

Nicholas Bloom

Raffaella Sadun

John Van Reenen

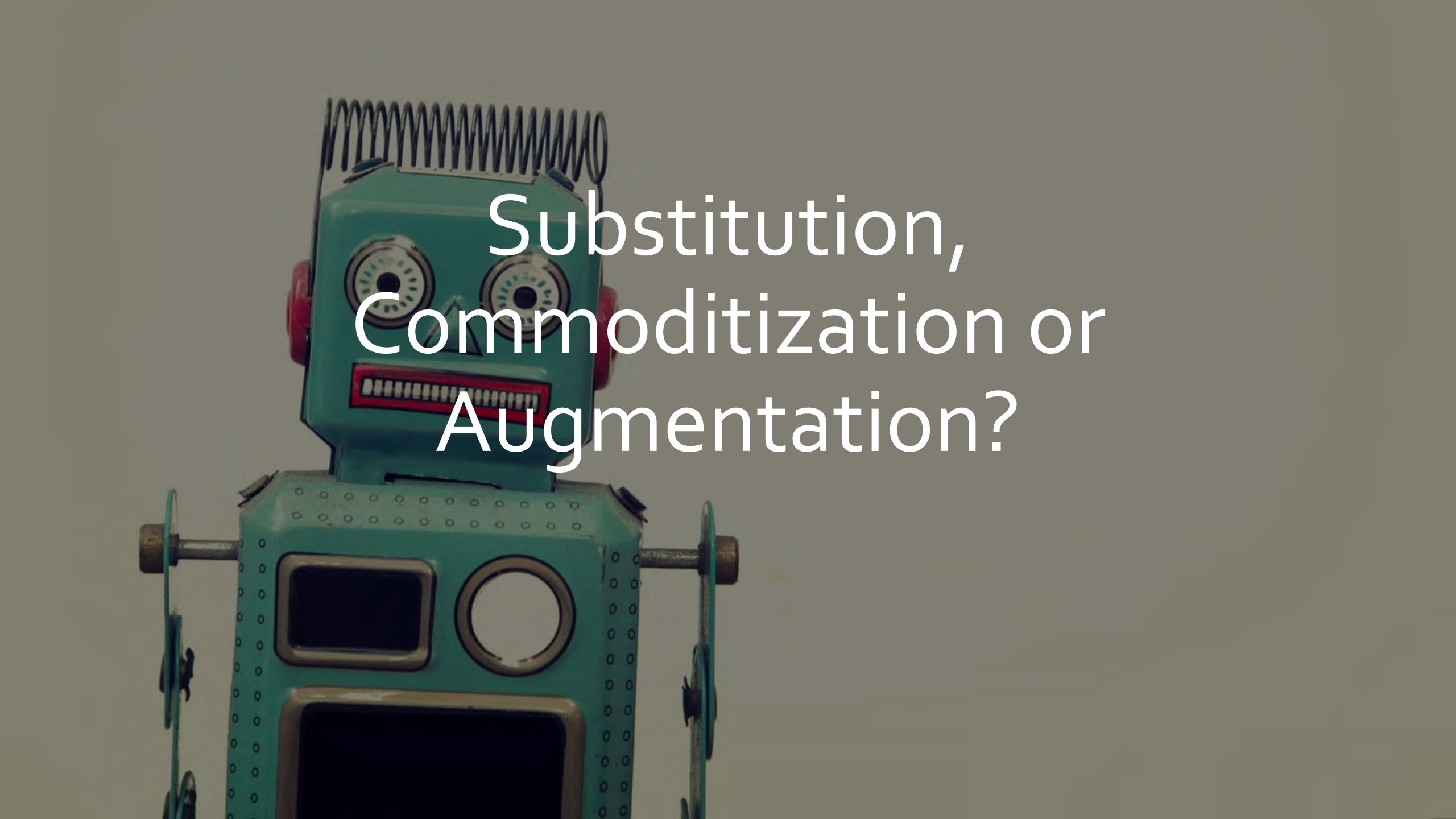
AMERICAN ECONOMIC REVIEW
VOL. 102, NO. 1, FEBRUARY 2012
(pp. 167–201)

Are we able to deeply rethink our economic systems and organizations based on new technologies?

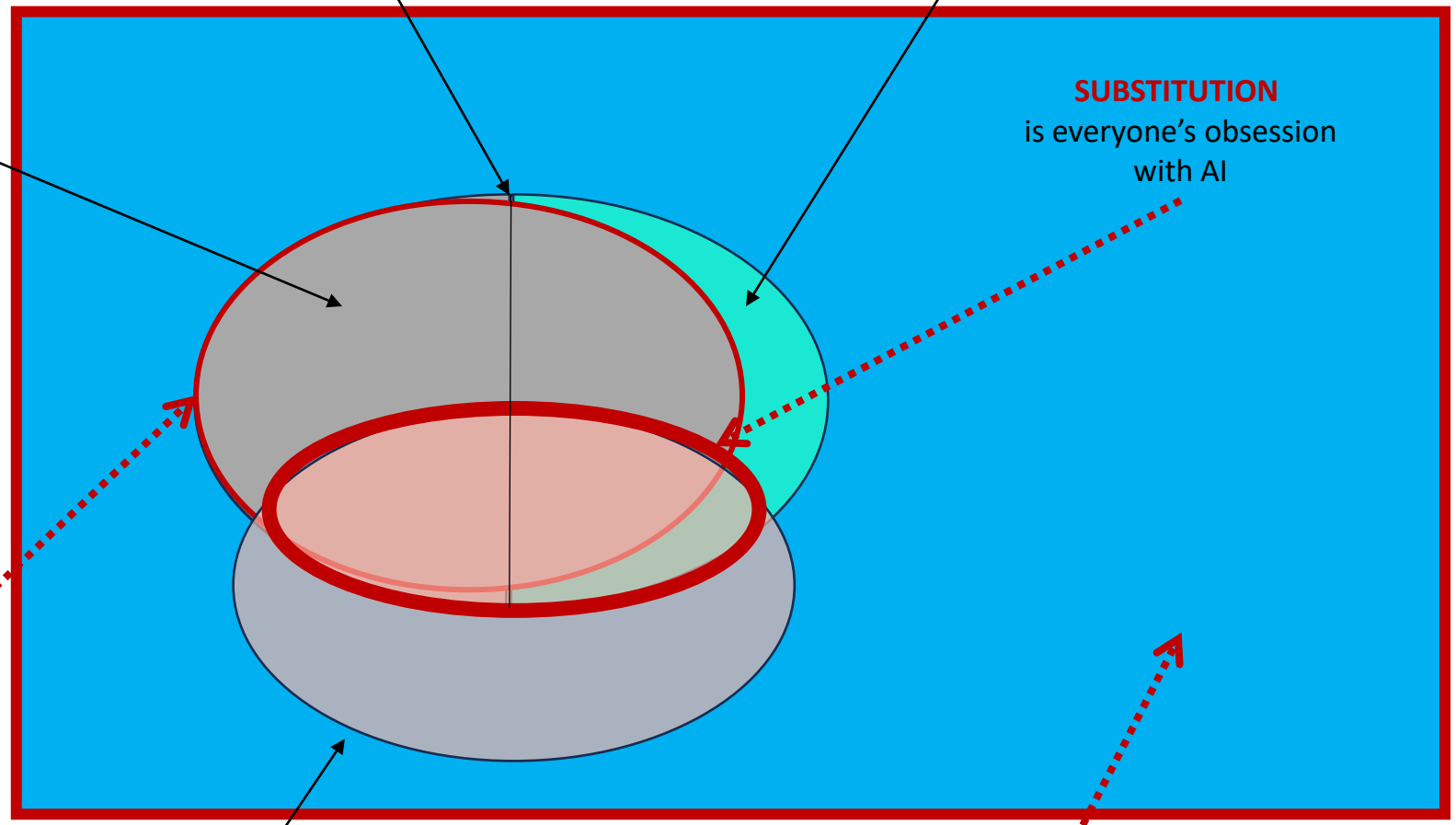
Are we solving the right problem?

“There is nothing quite so useless as doing with ~~great efficiency~~ AI something that should not be done at all”

Peter Drucker

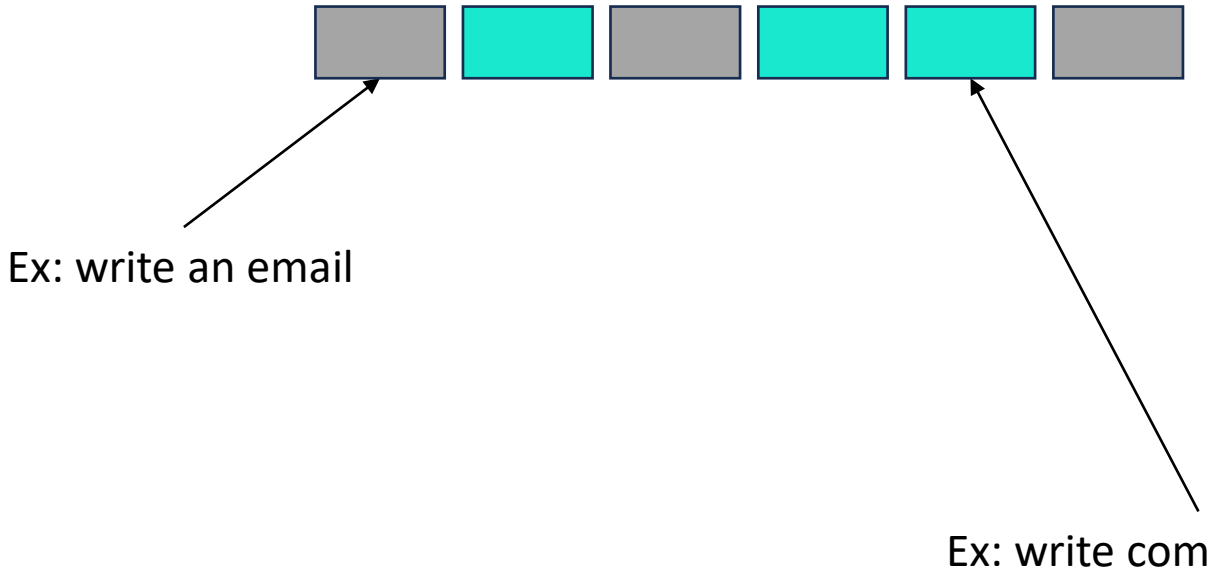

Substitution,
Commoditization or
Augmentation?

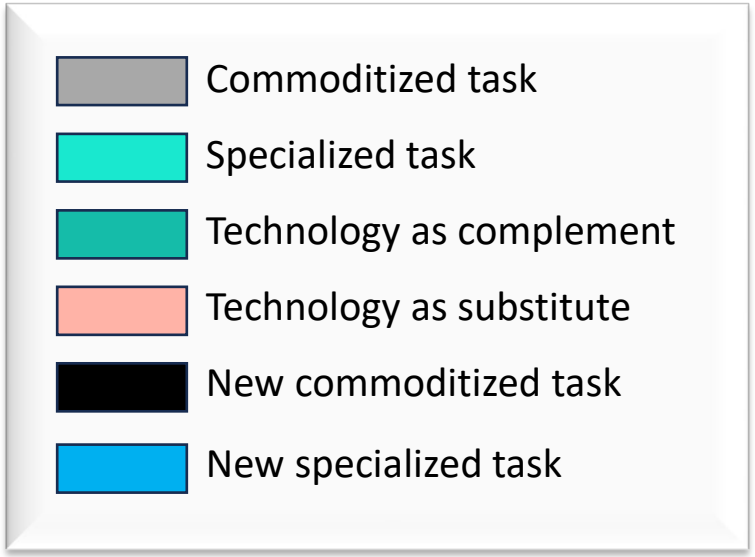
Substitute, commoditize, OR Augment?



Source: Adapted from Brynjolfsson (2024)

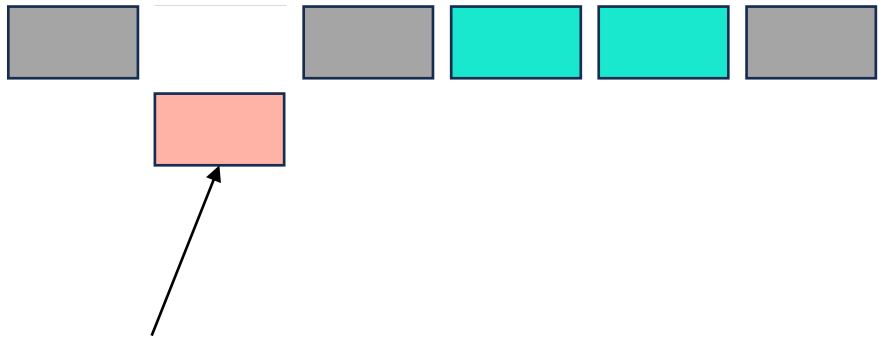
Any job or process is a bundle of tasks



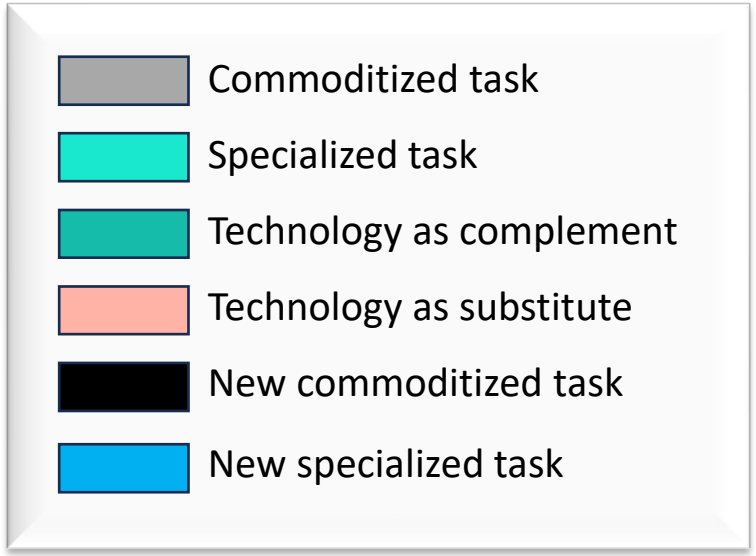


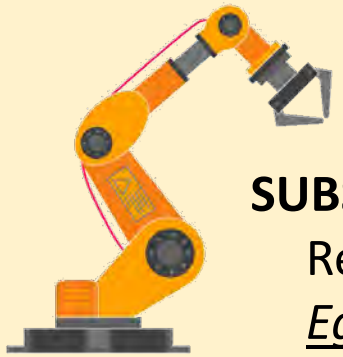
Source: Adapted from Choudary (2024)

AI Substitution



AI substitutes human skill, skill premium will decrease (skill gets irrelevant), productivity might **go up**

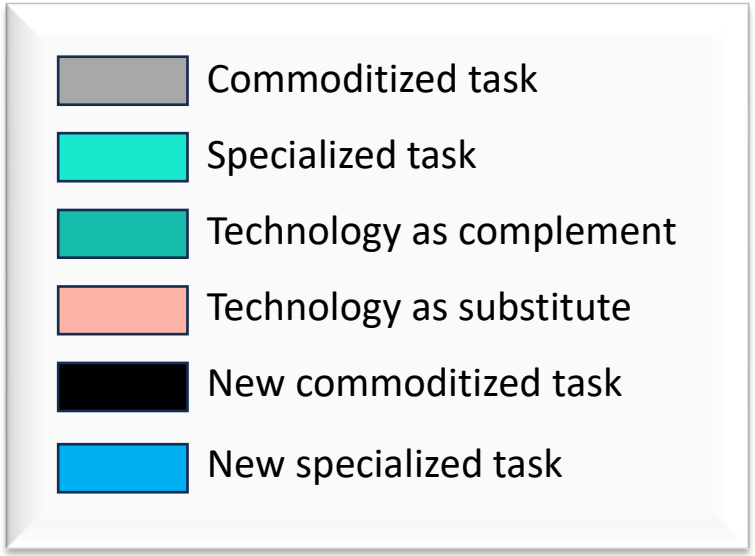




SUBSTITUTE:
Replace human work on specific task
Eg: Automatic translation

Source: Adapted from Choudary (2024)

Substitution can lead to more clerical tasks

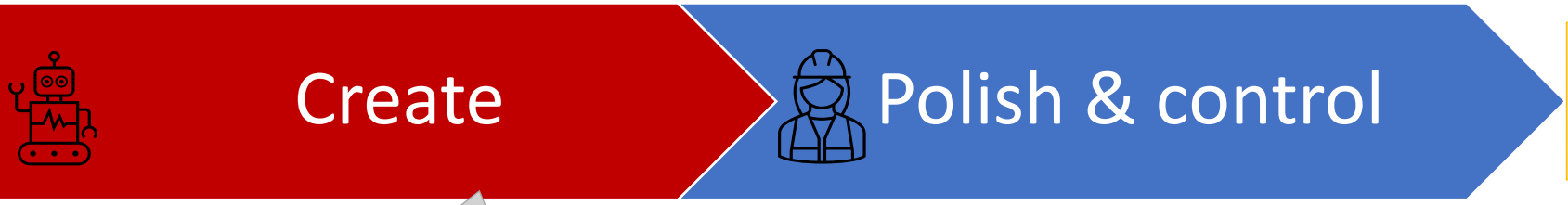


If augmentation leads to new commodified tasks in the job bundle, then job motivation decreases and productivity might **go down**

Source: Adapted from Choudary (2024)

Substitution is about putting AI first

AI 1st

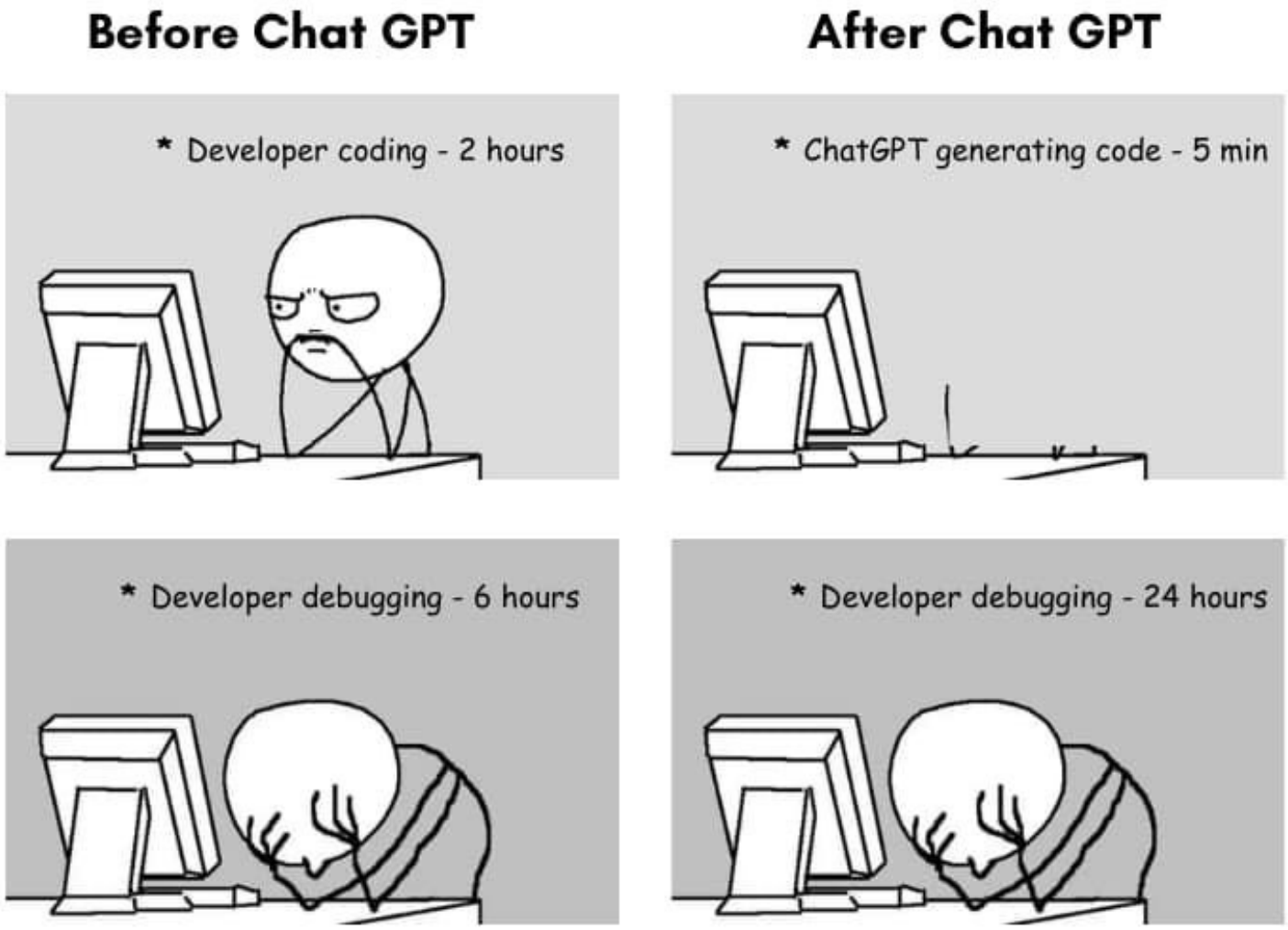


Maybe good for productivity
Bad for quality/motivation

Creates distrust (Jacovi et al. 2021), overreliance/complacency (Fügener et al. 2021), overcautiousness (Lu et al. 2023), hyperfocus on details (Wang et al. 2023)

AI increases control tasks…

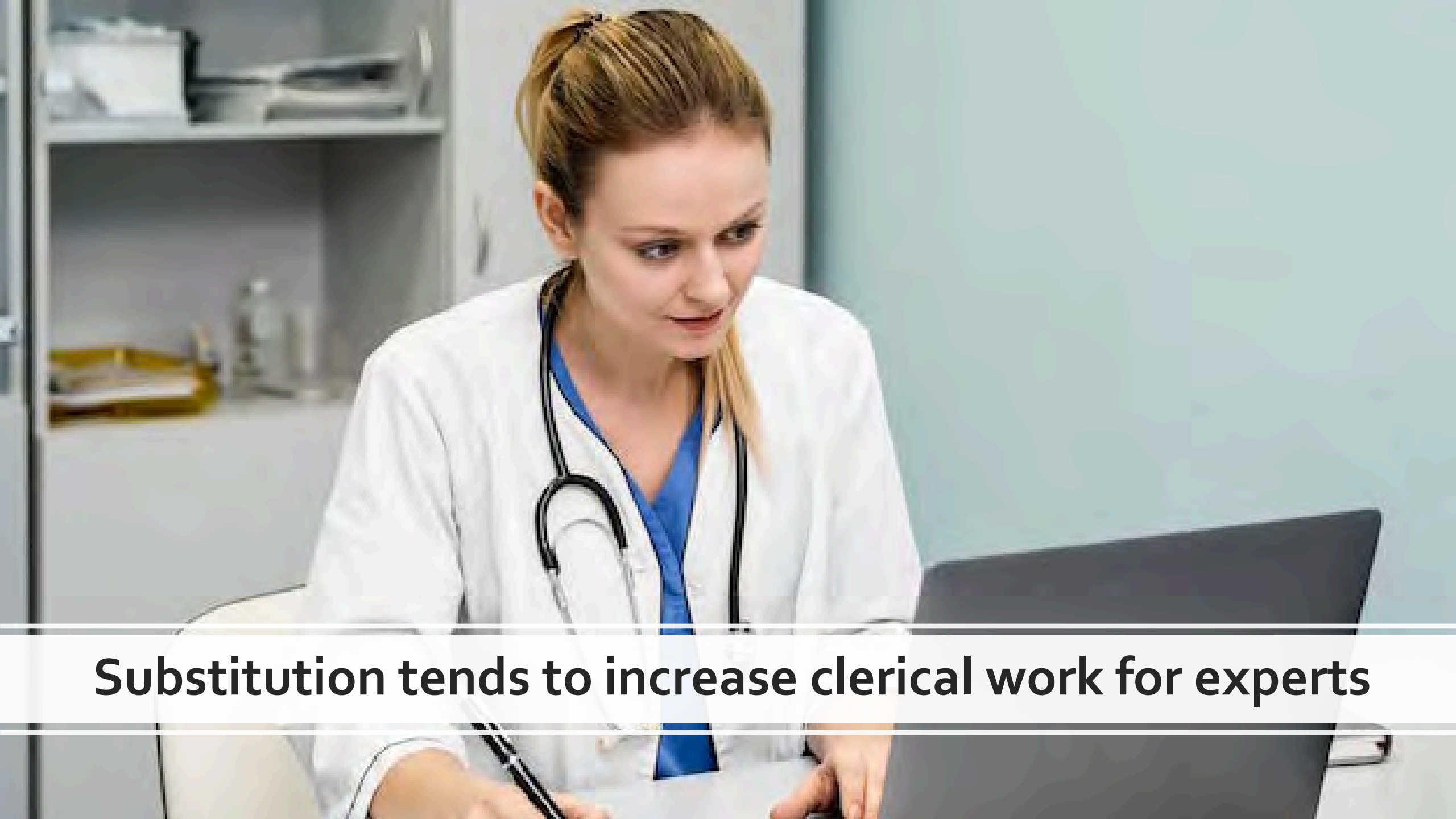
- As result requires high reliability, work shifts from code generation to code verification and debugging (Kreitmeir et Raschky, 2024)



A digital paradox?

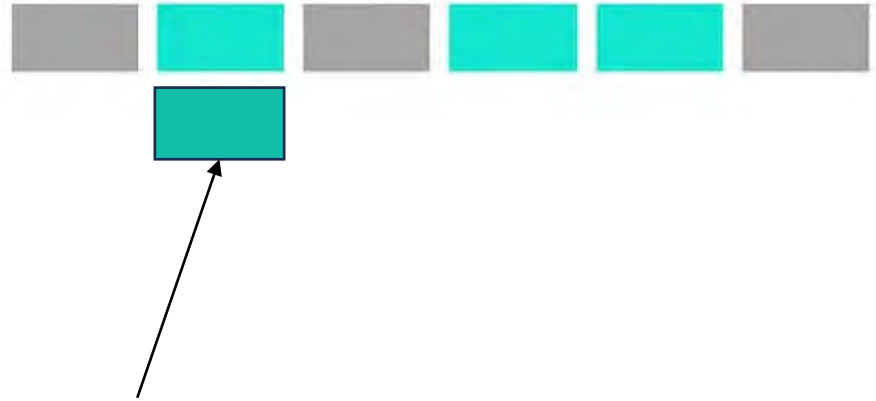
The more we automate productive tasks…

…the more clerical work we create

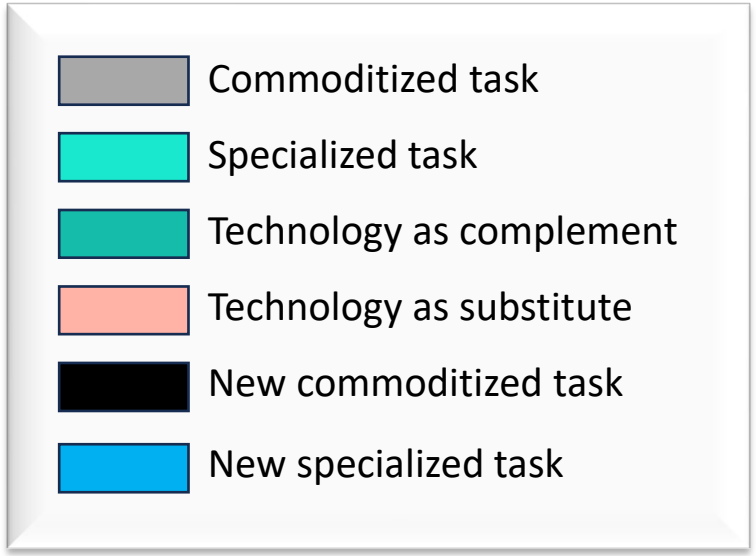


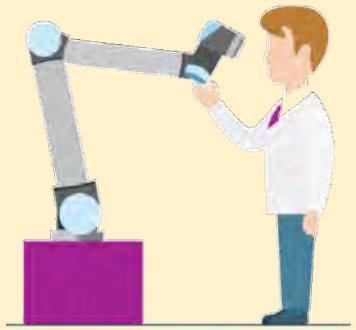
Substitution tends to increase clerical work for experts

Augmentation enhances value of existing skills



If AI augments human skill, then skill premium will increase

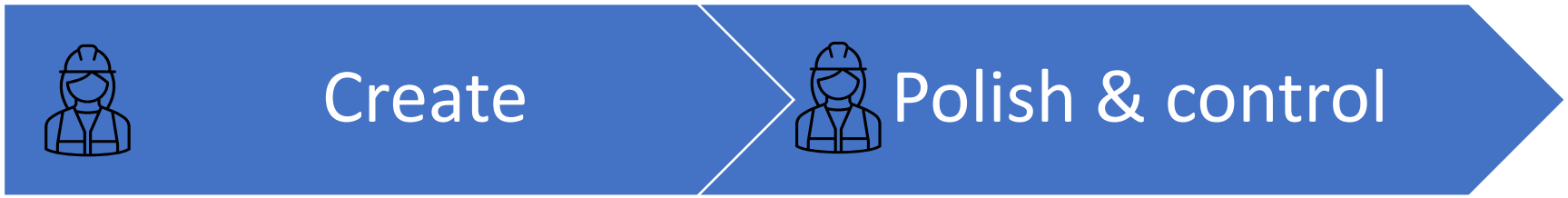




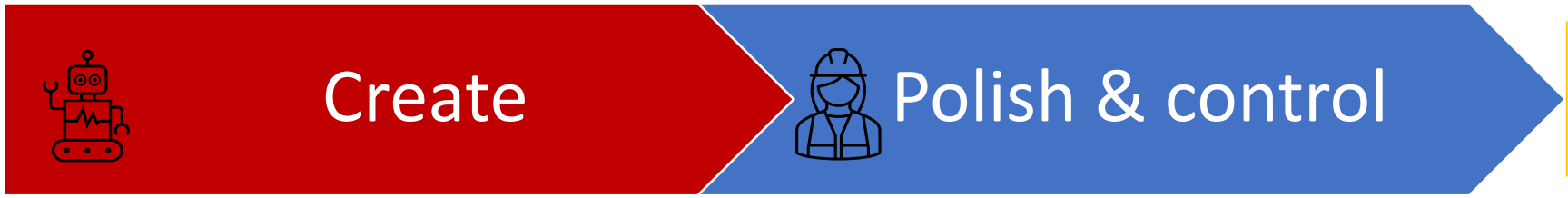
AUGMENT:
Enable humans to accomplish tasks they could not achieve (as well / as fast / at all) without technology
Eg: AI-augmented loan decisions

Source: Adapted from Choudary (2024)

Augmentation is often putting AI second

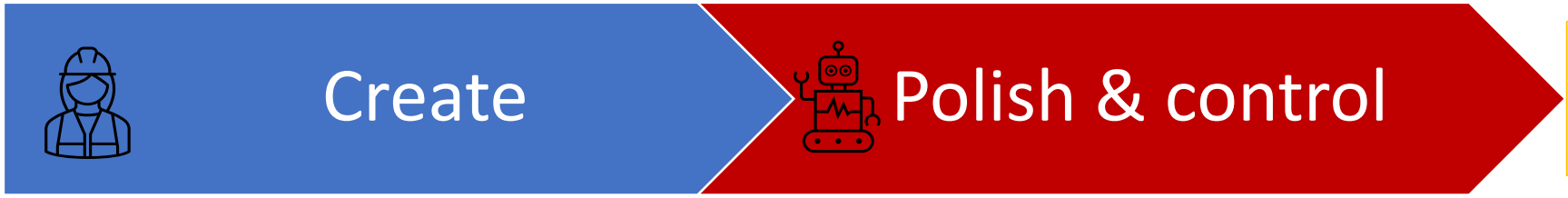


AI 1st



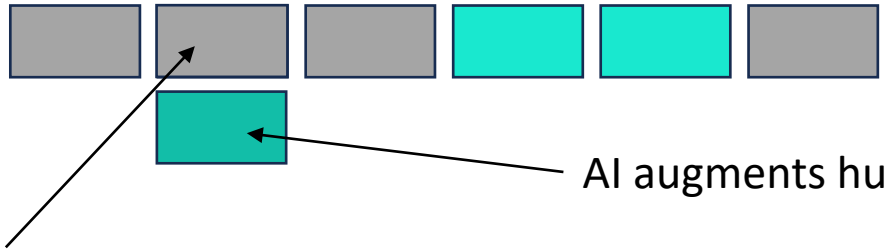
Maybe good for productivity
Bad for quality/motivation

AI 2nd



Good for quality/motivation
Less good for productivity

Augmentation can lead to commoditization



If augmentation lowers skill barrier to task, then skill premium will decrease (skill gets commodified) and AI can reduce skill-based inequalities

- Commoditized task
- Specialized task
- Technology as complement
- Technology as substitute
- New commoditized task
- New specialized task

COMMODITIZE:
Enable low-skilled workers to achieve task
Eg: No code programming

Source: Adapted from Choudary (2024)

AI-enabled commoditization

write a piece of Python code to play tic tac toe

Here's a simple implementation of a Tic Tac Toe game in Python that you can play in the console. This code handles the game board, player moves, and determines the winner or if the game ends in a draw.

python Copy code

```python
import random

def print_board(board):
    print("---------")
    for row in board:
        print("|".join(row))
        print("---------")

def check_winner(board, player):
    for row in board:
        if all([cell == player for cell in row]):
            return True
    for col in range(3):
        if all([board[row][col] == player for row in range(3)]):
            return True
    if all([board[i][i] == player for i in range(3)]) or all([board[i][2 - i] == pl
        return True
    return False

def is_draw(board):
    return all([cell != ' ' for row in board for cell in row])

def get_player_move():
    while True:
```

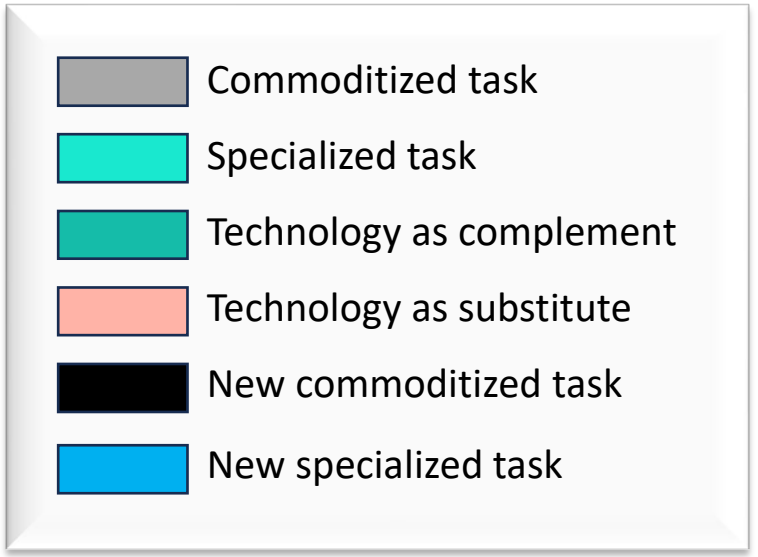
Automation of one’s task is generally augmentation of another one’s job through commoditization

Commoditization implies that the least qualified benefit the most from AI

Paper	Field	AI Technology	Productivity gain	Heterogenous effect
Noy and Zhang, 2023	Writing tasks	ChatGPT	+40%	Quality differences between low and high skilled disappear
Brynjolfsson, Li and Raymond, 2023	Call center tasks	Chatbot	+14%	Gain among most skilled / experienced: 0% Gain among least skilled / experienced: +34%
Kanazawa et al., 2022	Taxi drivers cruising tasks	AI Routing	+14%	The most qualified / experienced drivers lose, the less qualified win
Dell'Acqua et al., 2023	Consulting tasks	ChatGPT	+25%	Gain among most skilled / experienced: +17% Gain among least skilled / experienced: +43% **-19% for tasks outside of ChatGPT's frontier**


AI seems like an equalizer

Best if augmentation leads to new value creation



If AI augments human skill, then skill premium will increase

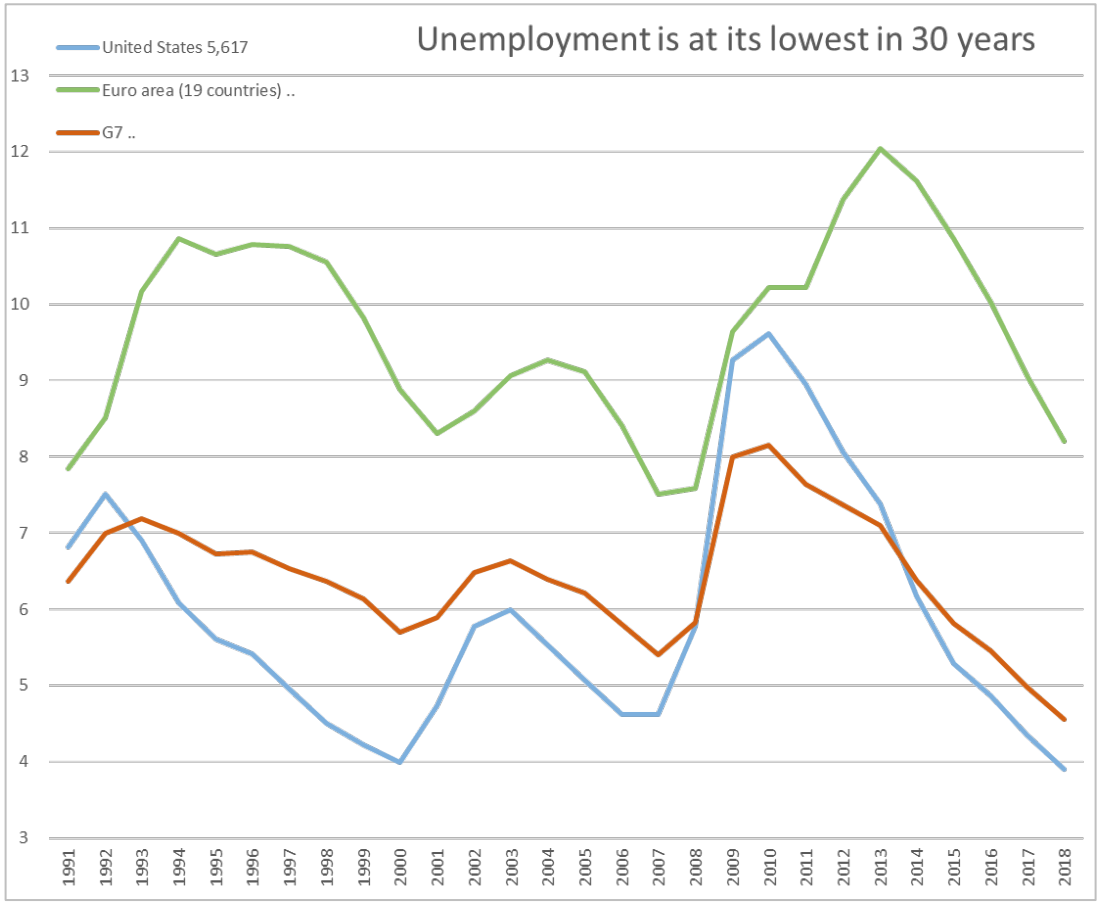
If augmentation leads to new specialized task in the job bundle, then value creation is maximized

Source: Adapted from Choudary (2024)

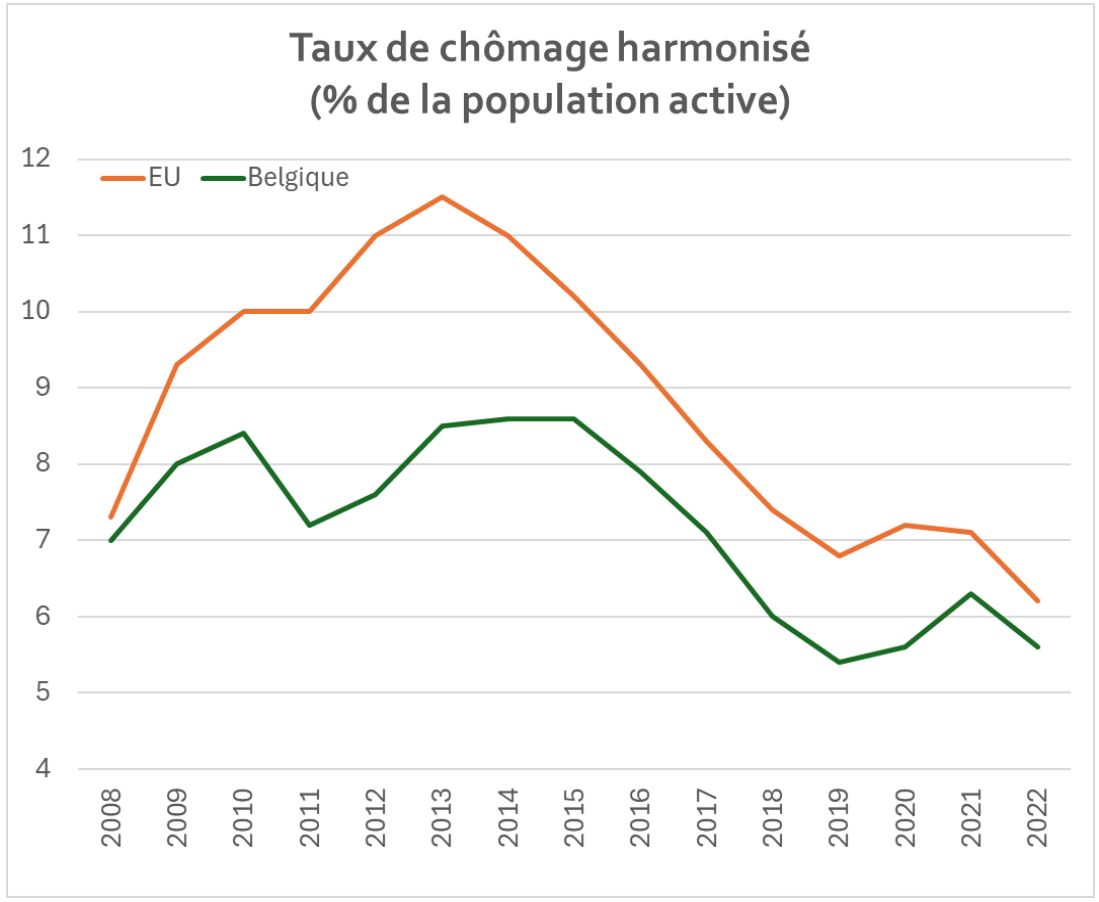

AI augmentation leads to new ways of applying human expertise


Will this kill jobs?

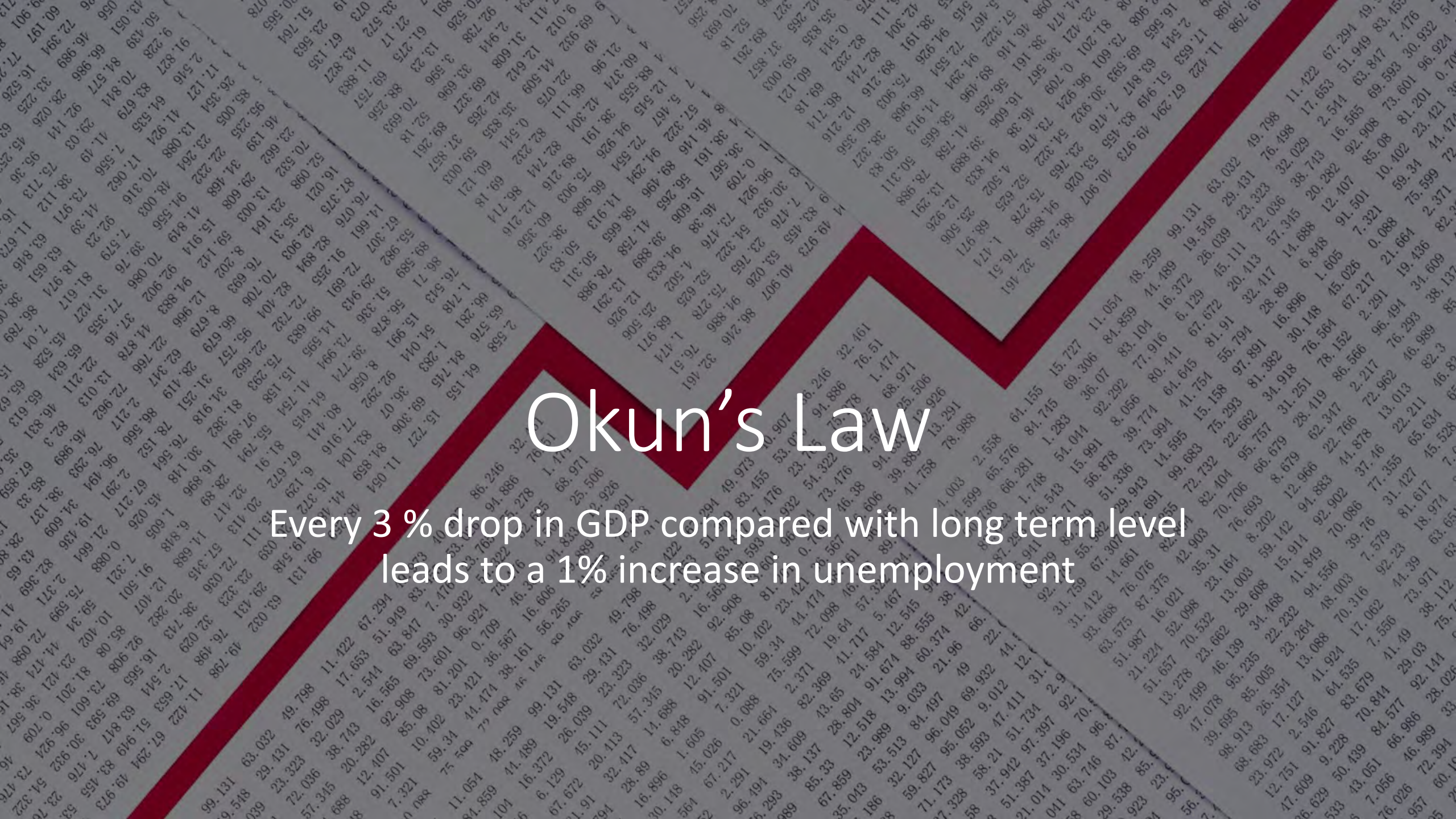
Technology destroys jobs massively?



Source: OECD Harmonized Unemployment Rates data



Source: Conseil Supérieur de l'Emploi (2023)

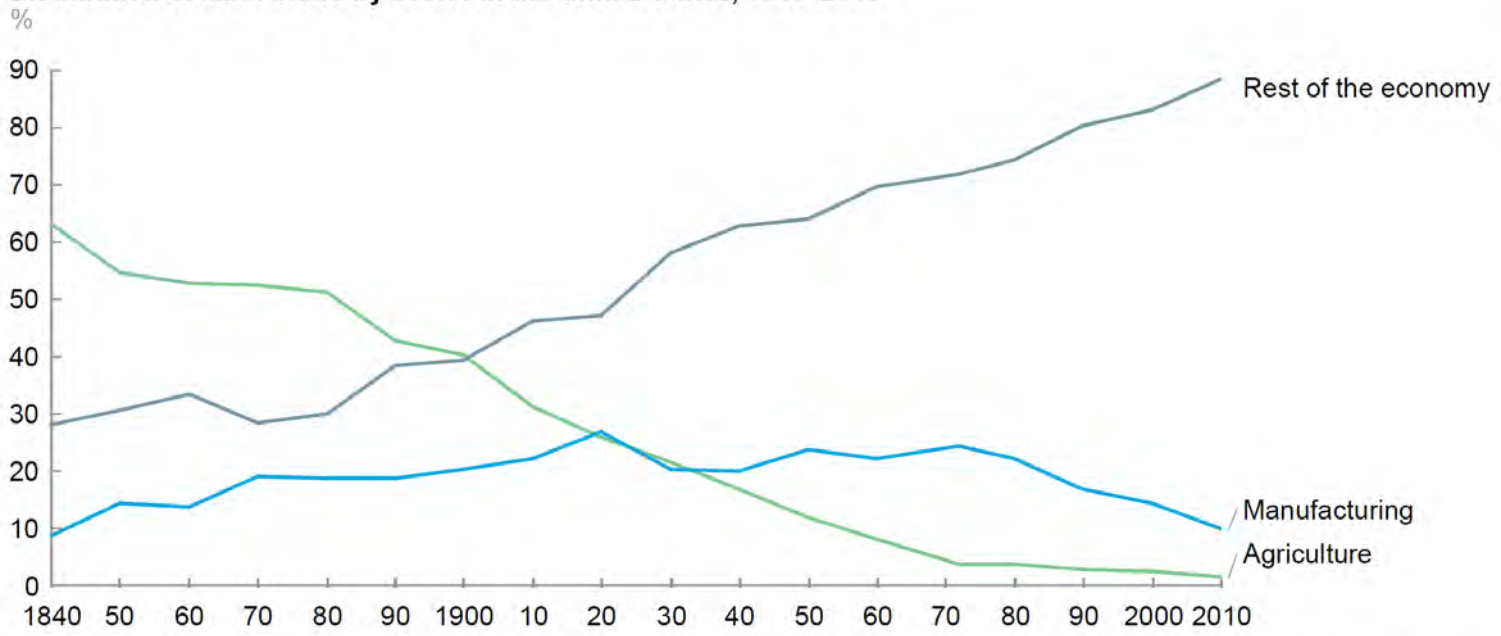


Okun’s Law

Every 3 % drop in GDP compared with long term level leads to a 1% increase in unemployment

Does technology kill or create jobs?

Distribution of labor share by sector in the United States, 1840–2010



SOURCE: Stanley Lebergott, "Labor force and employment 1800–1960," in *Output, employment, and productivity in the United States after 1800*, Dorothy S. Brady, ed., NBER, 1966; World Data Bank, World Bank Group; FRED: Economic Research, Federal Reserve Bank of St. Louis; Mack Ott, "The growing share of services in the US economy—degeneration or evolution?" *Federal Reserve Bank of St. Louis Review*, June/July 1987; McKinsey Global Institute analysis

Over time, technology creates new jobs

Frontier jobs

- Supervisor, Word Processing (1980)
- Circuit Layout Designer (1990)
- Artificial Intelligence Specialist (2000)
- Echocardiographer (2000)
- Wind Turbine Technician (2010)
- Computing Services Director (2016)

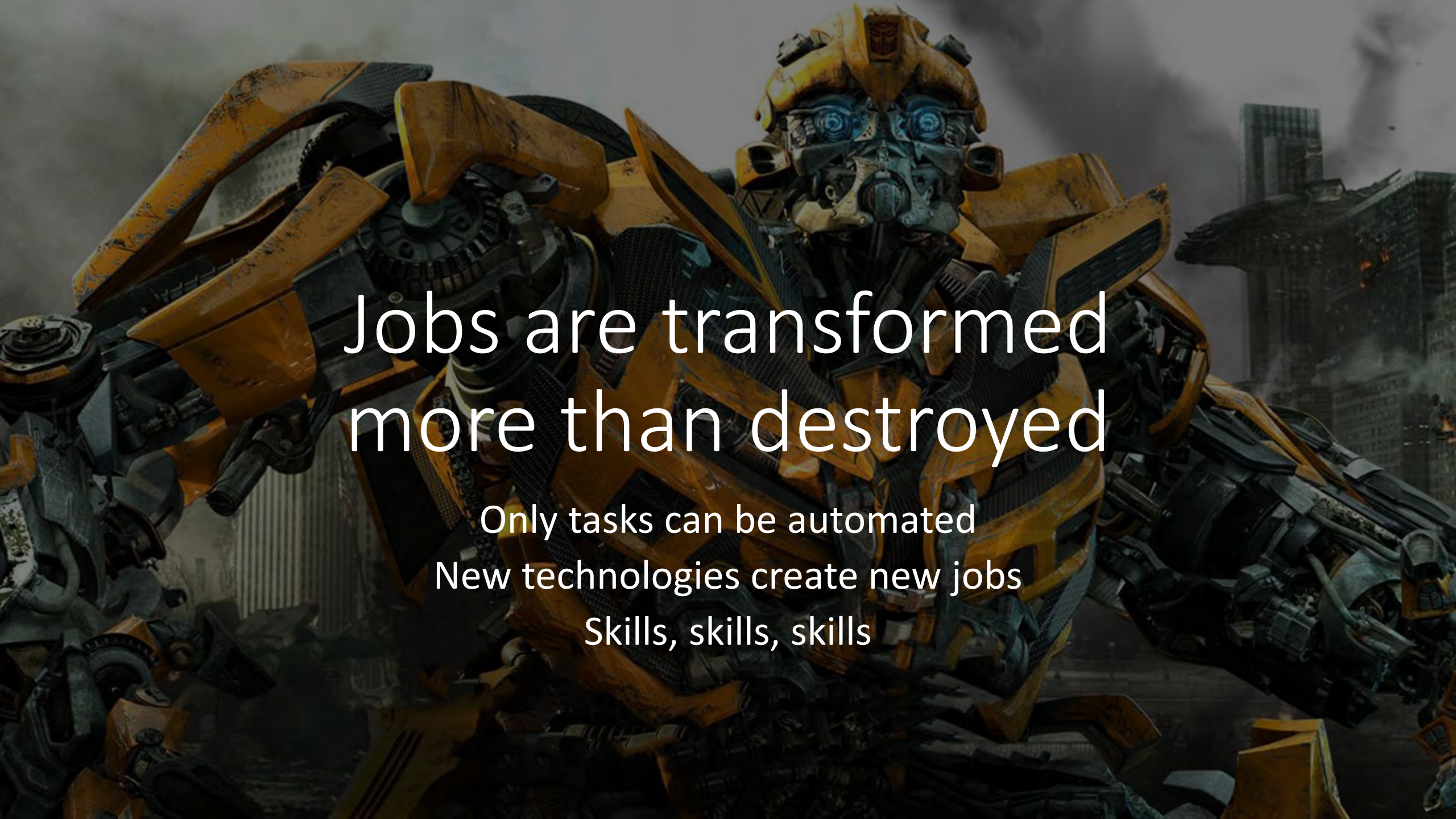
Luxury jobs

- Gift wrapper (1980)
- Fingernail former (1990)
- Horse exerciser (2000)
- Oyster preparer (2000)
- Sommelier (2010)
- Golf cart mechanic (2016)

Last mile jobs

- Tamale-machine feeder (1980)
- Vending-machine attendant (1990)
- Chat room host/monitor (2000)
- Underground utility cable locator (2010)
- Teleprompter (2016)

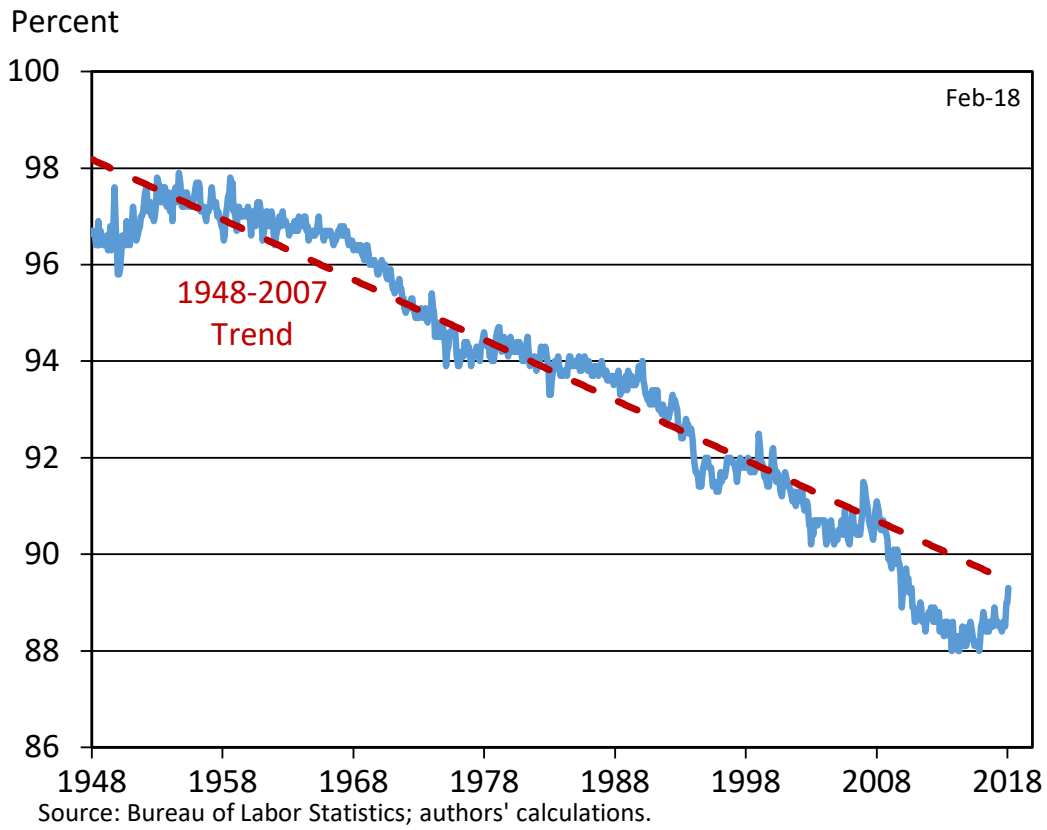
Source: Autor (2019), based on Census Bureau data (US)


Jobs are transformed
more than destroyed
Only tasks can be automated
New technologies create new jobs
Skills, skills, skills

Grand challenges facing humanity will create huge demand for work

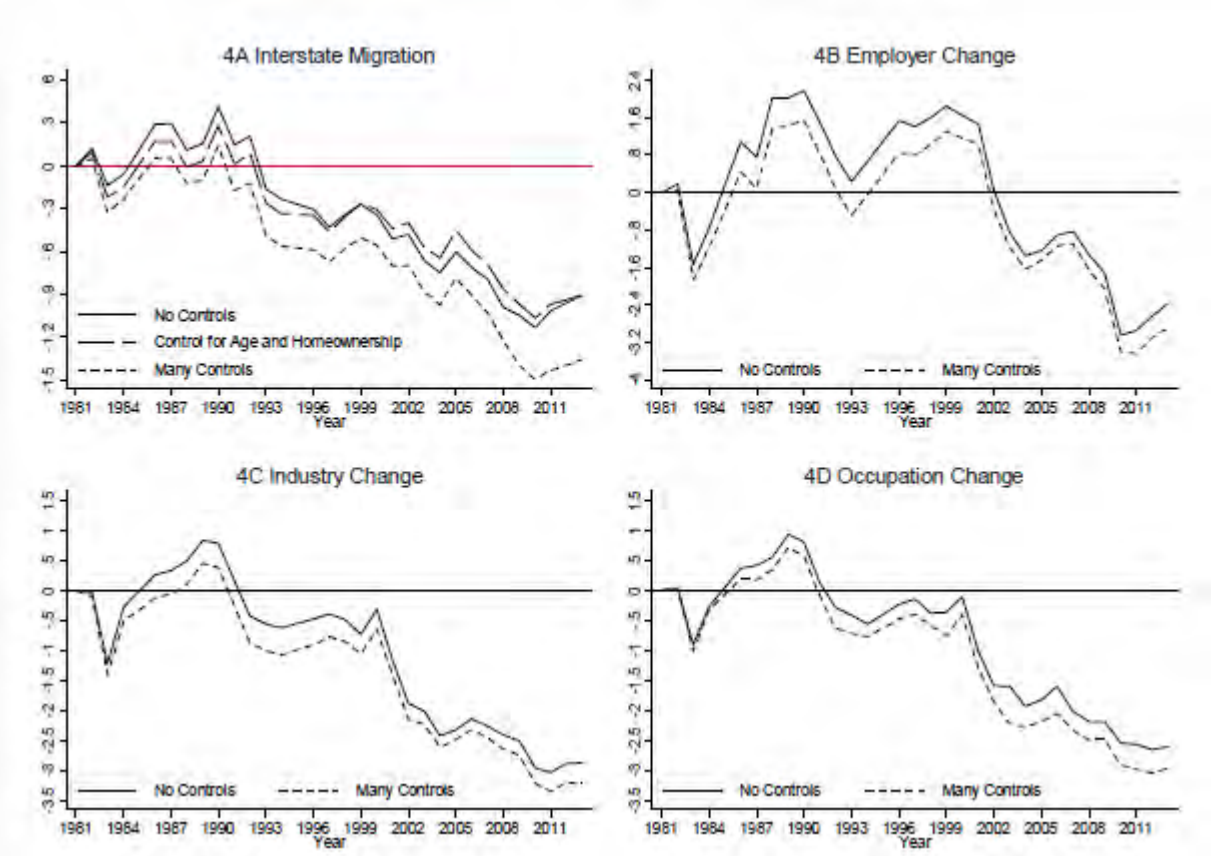
Population is ageing…

Prime-Age Male Labor Force Participation Rate



Source: Bureau of Labor Statistics; authors' calculations.

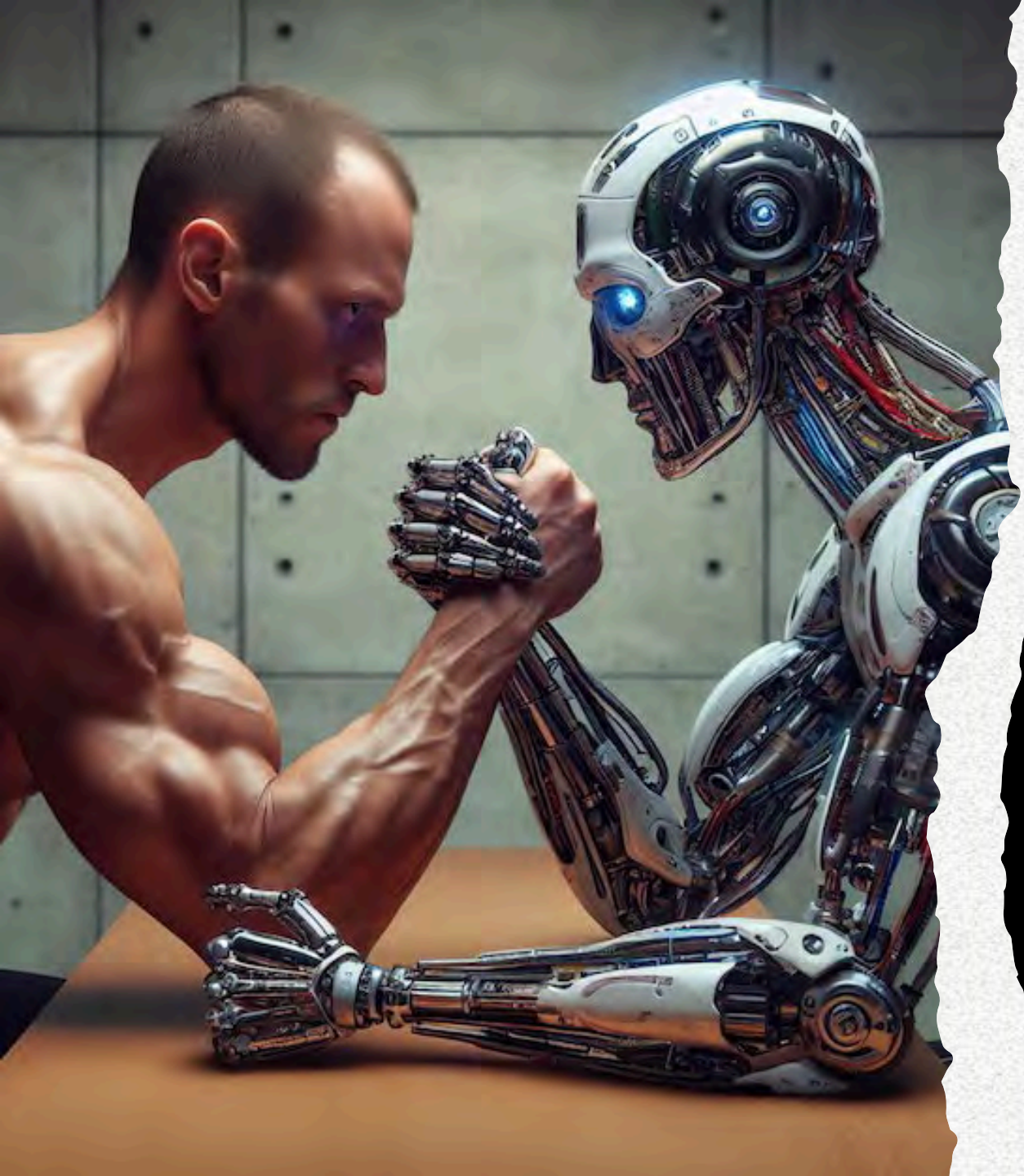
Job Change and Decline in Long-Distance Migration in US



Molloy, Smith, Wozniak (2016)

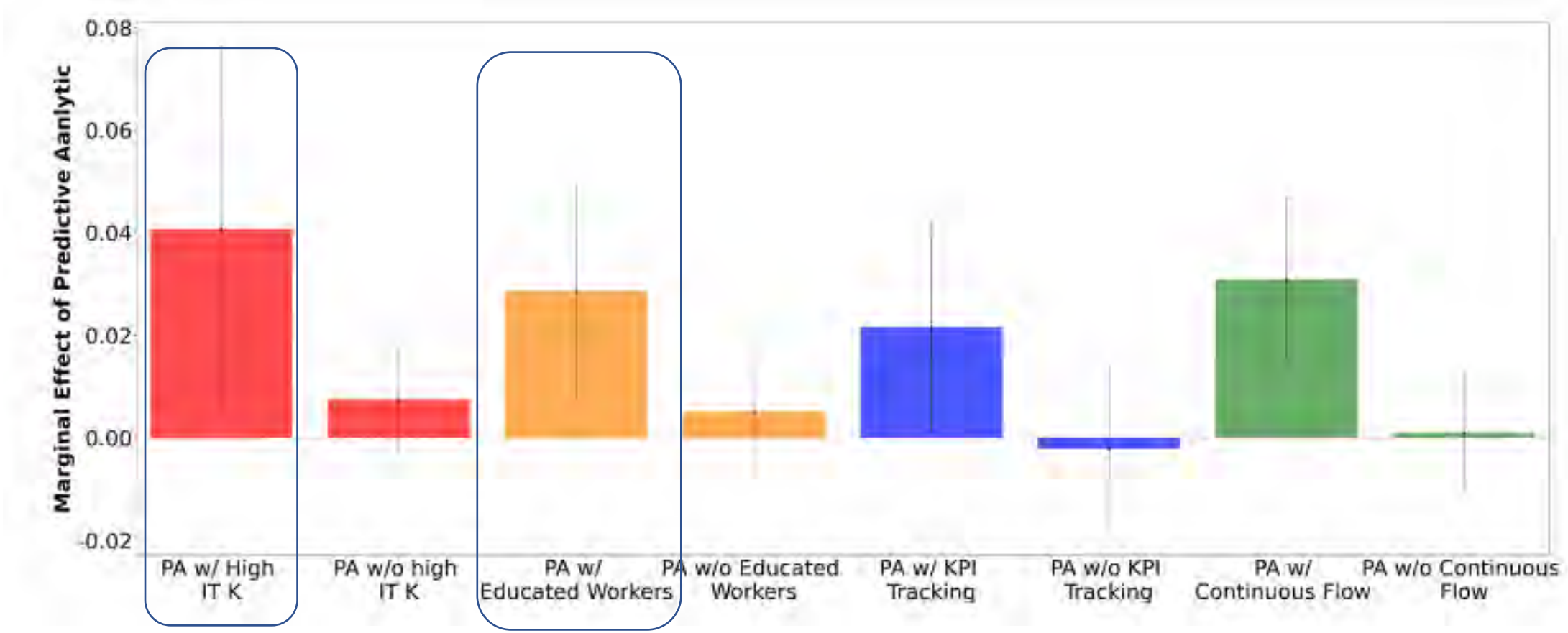
Source: Seamans (2023)


We badly need big productivity gains,
and we cannot waste the AI
opportunity to do so



A race
with or against
the machine?

AI doesn't pay off without human skills…



Source: Erik Brynjolfsson and Kristina McElheran (2021)

Separating productive/creative tasks from clerical/control tasks is the worse possible use case

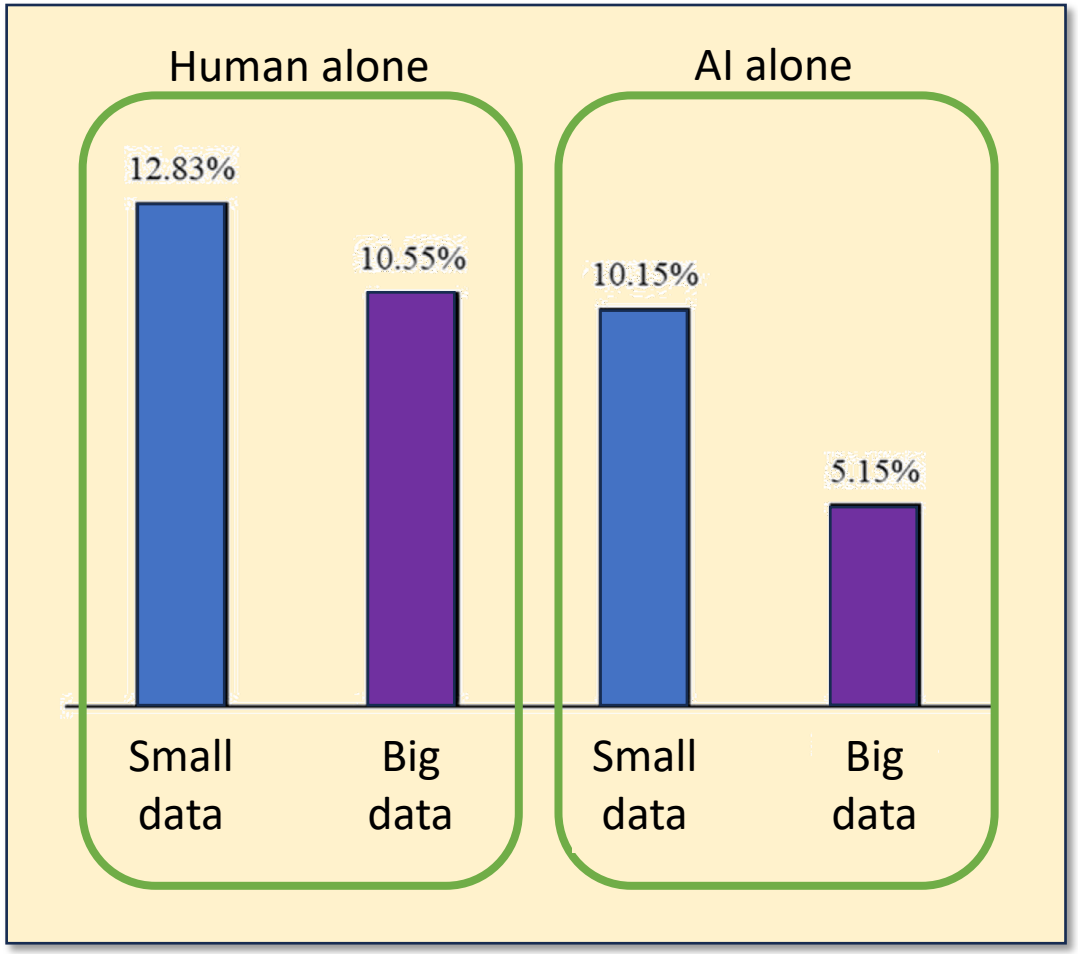
What AI is good at

- Processing huge volumes of data
- Never getting bored
- Picking anomalies
- Finding regularities/patterns

What humans are good at

- Deep thinking
- Thinking out of the box / inventing
- Using experience to process low-frequency cases
- Flexibility and adaptation to unexpected circumstances

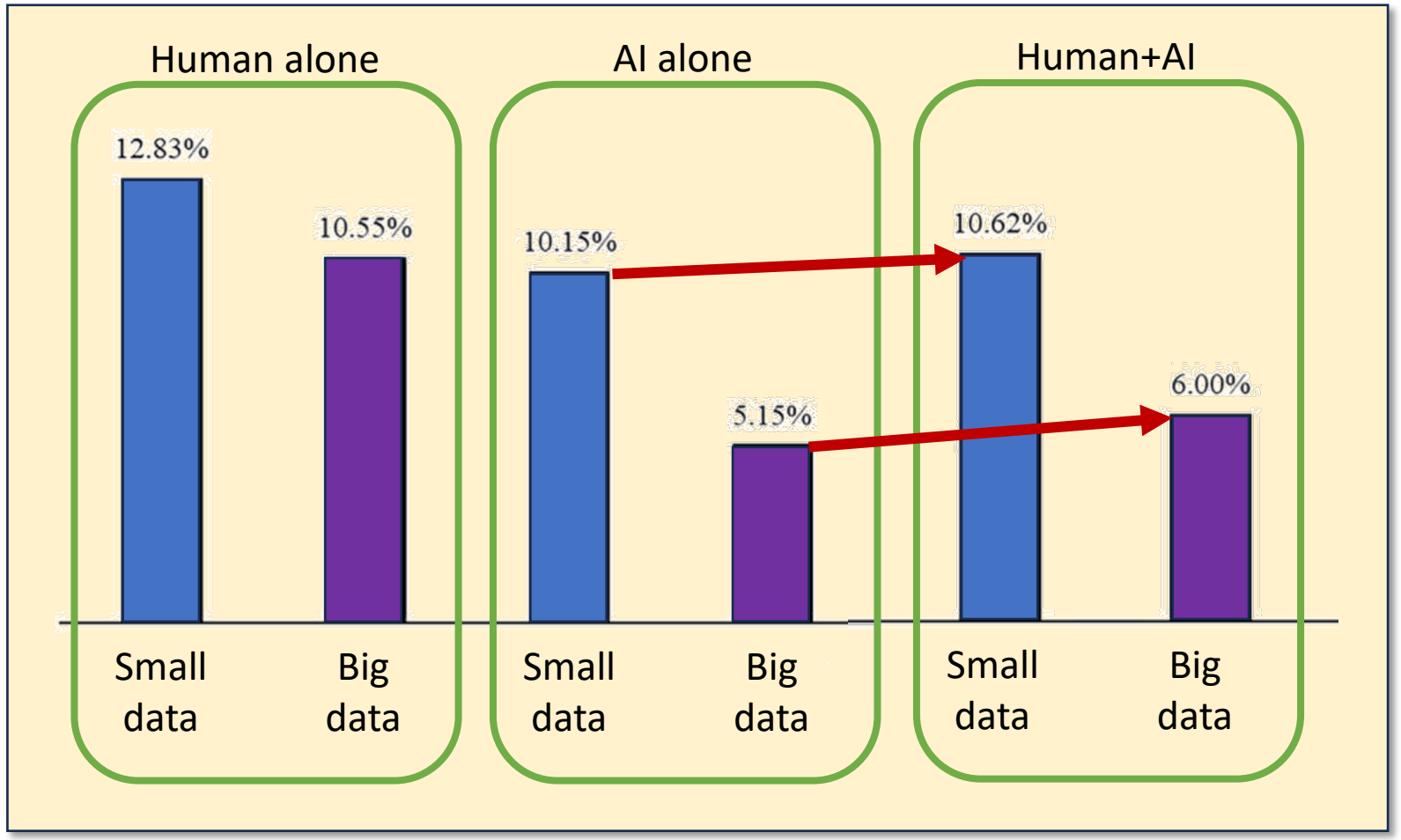
Impact of AI on quality of micro-credit decisions (default rate)



- AI outperforms Human
- AI is better at exploiting big data

Source: Lu & Zhang (2024)

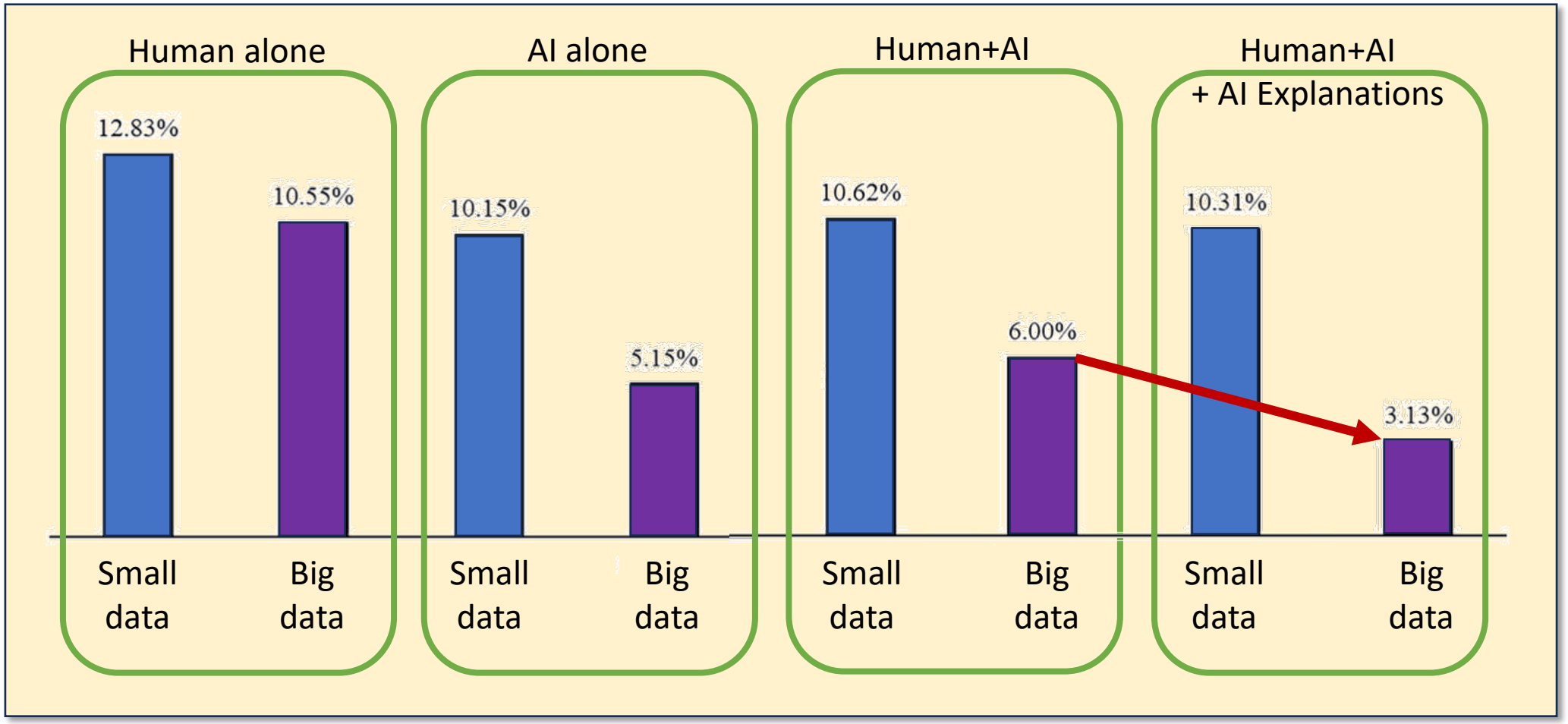
Impact of AI on quality of micro-credit decisions (default rate)



- Human augmented with AI does not seem to do better than AI alone

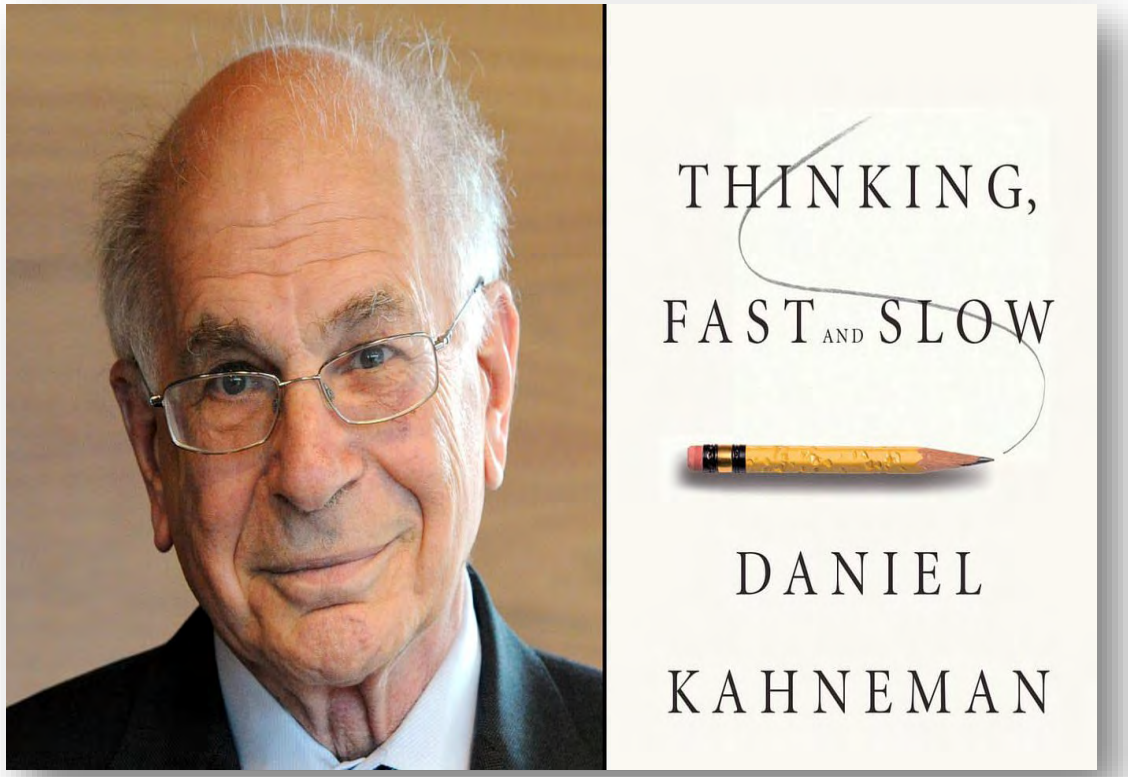
Source: Lu & Zhang (2024)

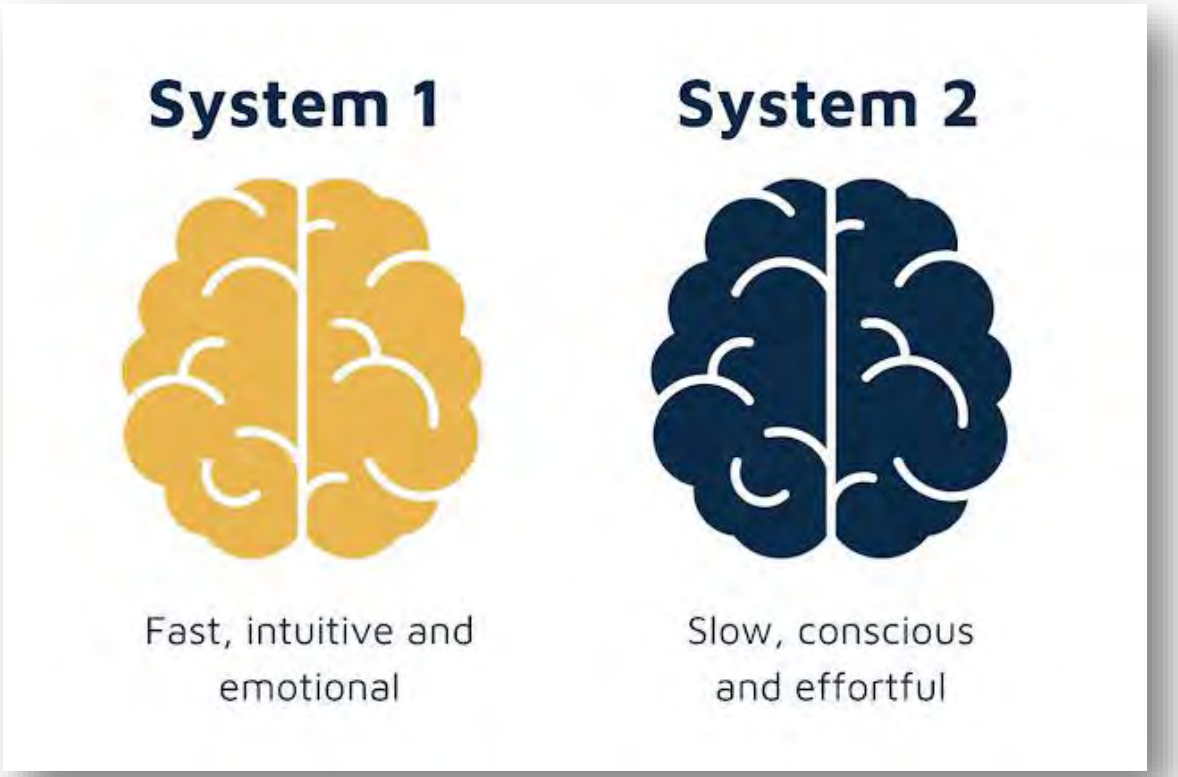
Best outcome when AI augments human skills while providing explanations



Source: Lu & Zhang (2024)

AI can easily deactivate our System 2






The real threats…

Europe as a spectator

Note: Market share is based on the number of units sold. Kuka is a German robot manufacturer owned by Chinese group Midea.
Consumer electronics excludes IT hardware such as PCs, laptops, servers, and mobile phones. Major appliances includes refrigeration appliances, home laundry appliances, dishwashers, large cooking appliances, and microwaves.

Source: Kearney analysis

5

A US-China matrix

ASML

imec

Source: ATKearney, 2021

Where are European platforms?

North America

63: $2.8 trillion

Asia

42: $670 billion

Europe

27: $161 billion

Africa & Latin America

3: $61 billion

North America has more platform firms than anywhere else in the world. China, with a large homogeneous market, is growing fast. Europe, with a more fragmented market, has less than $^{1}/_{10}$ the value of North America, not significantly far ahead of developing regions

$1B+ Platforms by Region

Source: P. Evans, CGE; CB Insights, Capital IQ, CrunchBase, 2015

92% EU data are stored in the US

[European Digital Sovereignty (oliverwyman.com)]

Données de santé des Français: l'hébergement chez Microsoft fait polémique

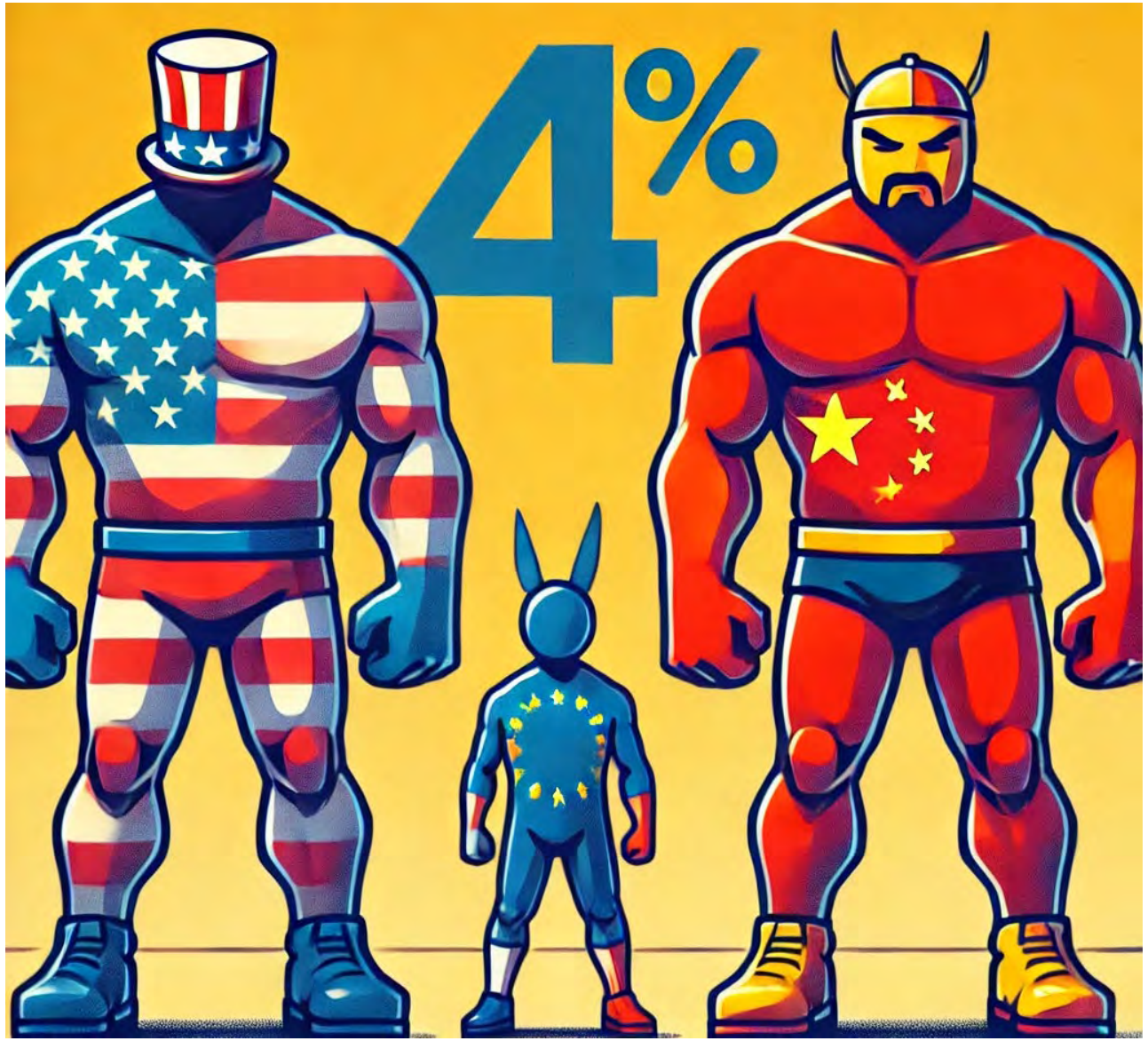
Par **Ingrid Vergara**
Publié le 07/02/2024 à 19:58, mis à jour le 08/02/2024 à 18:13

Copier le lien

Cette décision a suscité un vif émoi dans l'écosystème français des acteurs de la confiance numérique. *NicoElNino - stock.adobe.com*

Pour la première fois en France, la CNIL a dû faire une exception à ses règles, malgré le risque que ces données sensibles puissent être saisies par les États-Unis.

4% of globally deployed AI Accelerator FLOPs are in Europe



[AI Datacenter Energy Dilemma - Race for AI Datacenter Space (semianalysis.com)]

Why do the same players always win?

It’s a matter of scale…

Europe has a digital infrastructure investment deficit of €1000 to €1500 billions

Milliards €	USA	EUROPE
Chips (Chips Act)	250	~~43~~ (**3**)
Data Centers + 5G + Cybersecurity	500	1
Satellites	40 (SpaceX + Amazon)	13 (Eutelsat + IRIS)
Submarine cables	25	1
Amazon's logistics platform	100	0
Technology platforms	500	1
TOTAL	**1415**	**19**

BUSINESS INSIDER

TECH

Sam Altman wants to raise up to $7 trillion. That's, uh, a lot of dough.

Katie Notopoulos Feb 9, 2024, 8:29 PM CET

Share | Save

Sam Altman is looking to raise $5-7 trillion for the future of chip building. Jack Guez/AFP via Getty Images

- **Sam Altman is trying to raise up to $7 trillion to manufacture new chips to power AI.**

Main implications

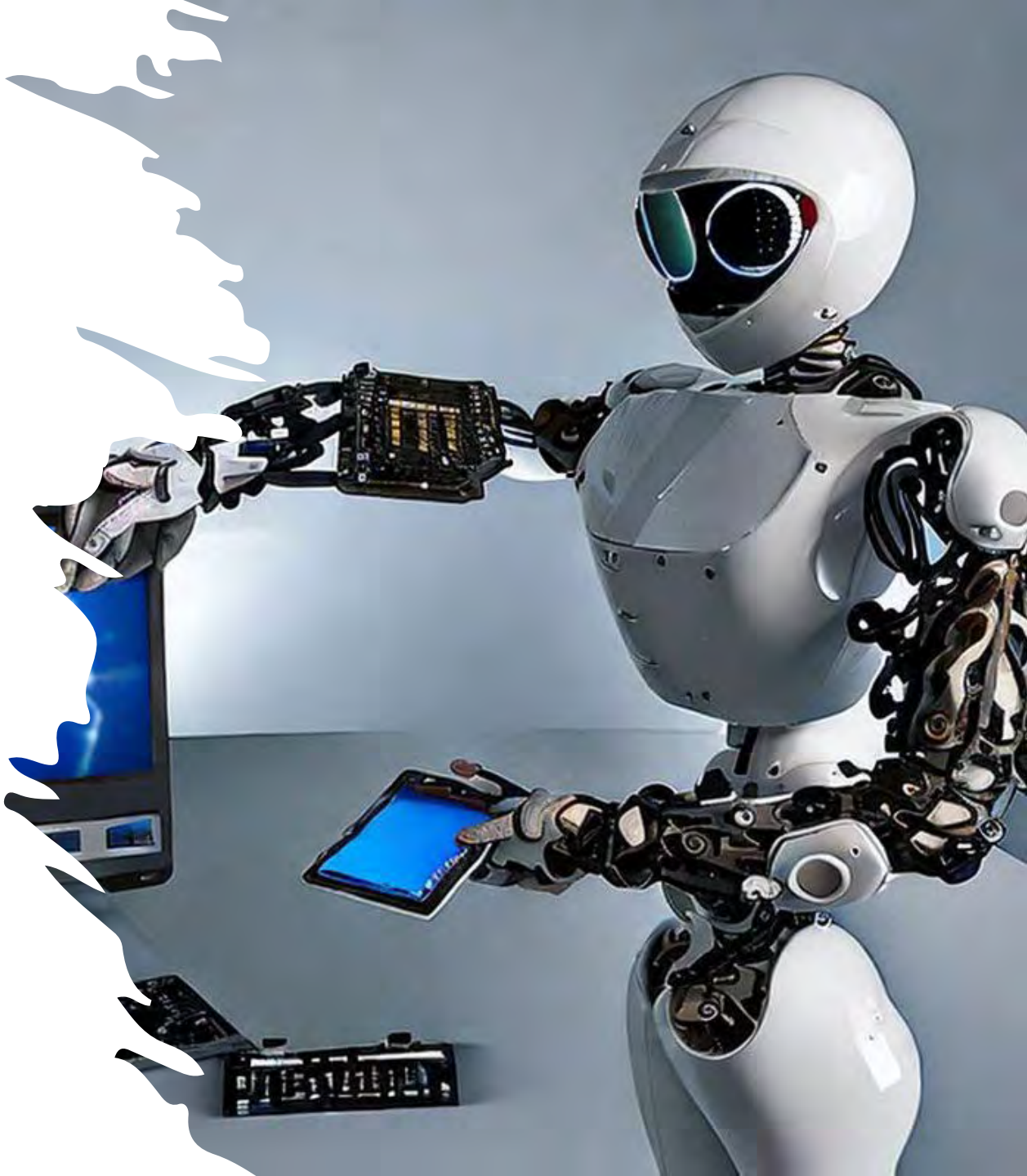
Very hard to play “small” in the digital (AI) economy

Europe must urgently and massively invest in AI infrastructure & applications

We must help our firms embrace digital & AI and deeply rethink their organizations and processes

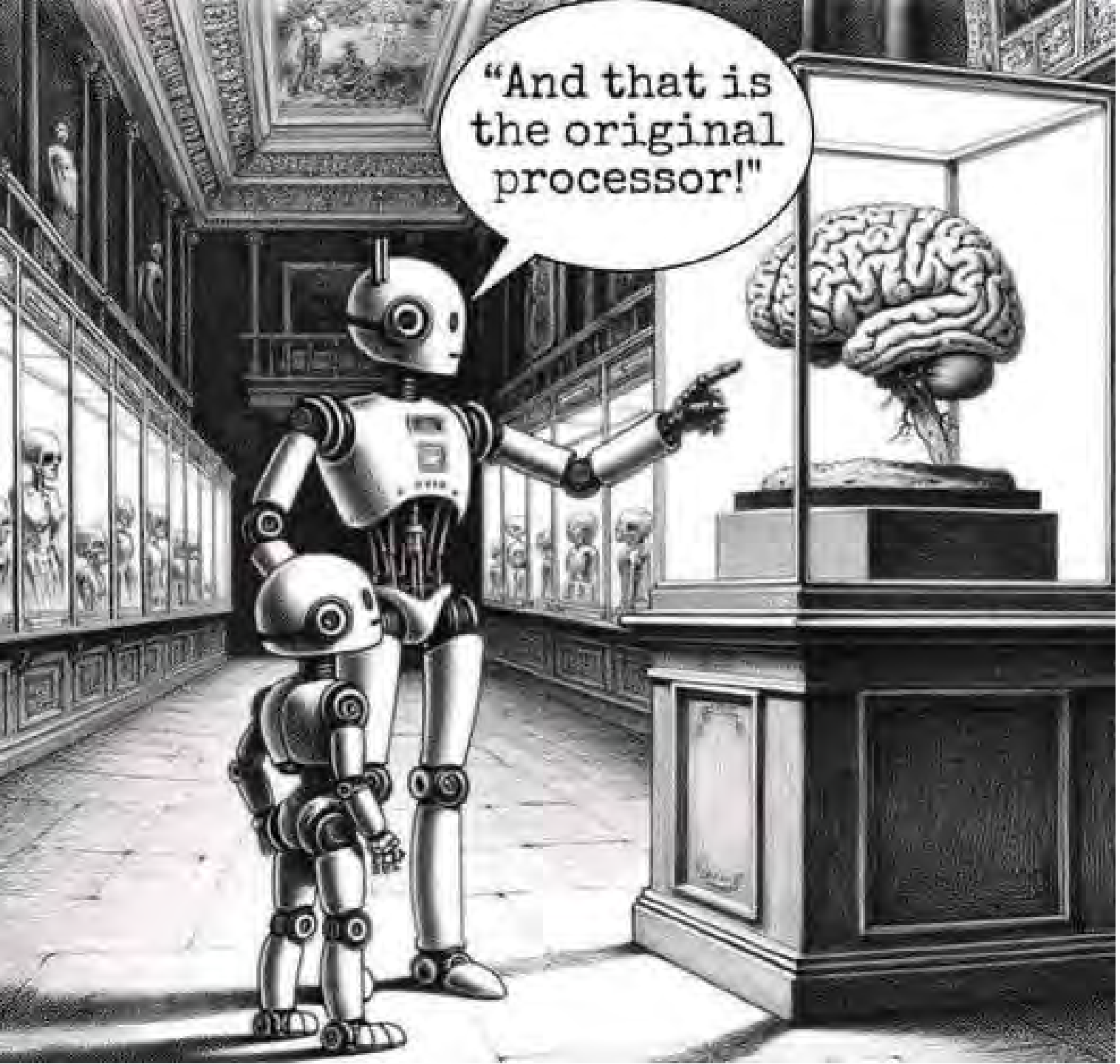
The best time to invest in AI was 10 years ago

The second best is now



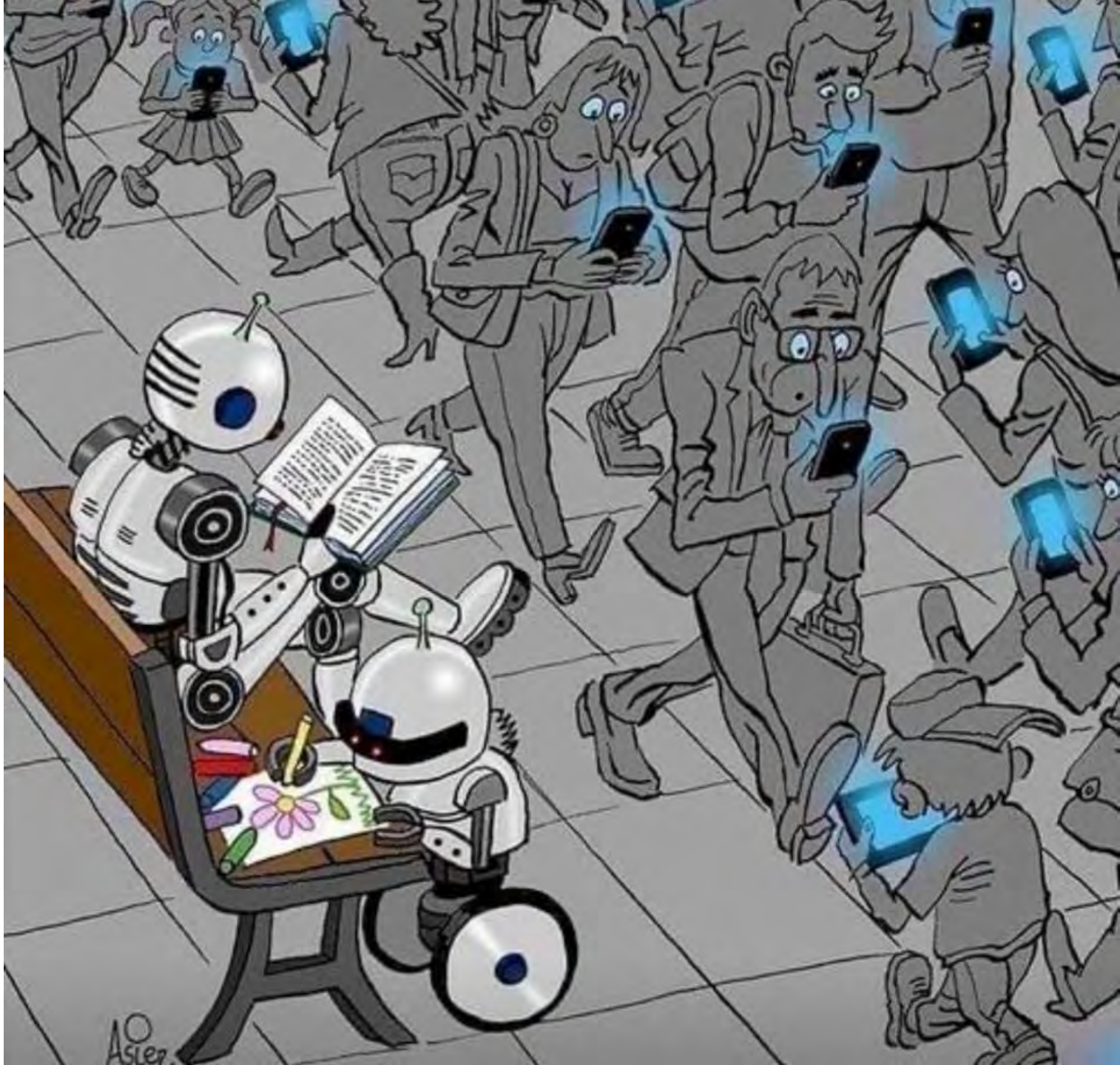
Firms need legal certainty but it would be a mistake to slow innovation down.

Other regions will not wait…



AI should invite us to think and work more and better, not less

We need to be careful in deploying AI to enhance our intelligence as firms, workers and citizens



Débats

L'ÉCONOMIE NUMÉRIQUE

ENJEUX ET RESSORTS D'UNE RÉVOLUTION

Nicolas van Zeebroeck

Éditions de l'Université de Bruxelles

Le numérique est partout, mais il n'est pas neutre. Alors qu'il promettait d'abattre les barrières et de démocratiser la planète, il a engendré une économie qui favorise les plus puissants et défie les régulations. Comment comprendre les enjeux et les ressorts de cette révolution ? Comment y faire face et en tirer parti ?

Ce livre constitue un guide de survie dans la jungle numérique en décryptant les mécanismes et les acteurs qui la façonnent et l'insuccès des tentatives de la réguler. Il donne des clés pour agir et innover dans ce monde en mutation.

Nicolas van Zeebroeck est professeur à la Solvay Brussels School of Economics and Management de l'Université libre de Bruxelles (ULB) où il enseigne les systèmes d'information et la stratégie numérique. Il est également adjoint des autorités de l'ULB pour l'informatique et le numérique et membre du Conseil supérieur de l'emploi en Belgique.

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